United States
Department of
Agriculture

Research and
Education Committee

June 1985

1984 Annual Report on the Food and Agricultural Sciences

From the Secretary of Agriculture to the President and the Congress of the United States

PREFACE

This report was prepared under the auspices of the USDA Research and Education Committee, which was established in 1981 as a unit of the Secretary of Agriculture's Policy and Coordination Council. The Assistant Secretary of Agriculture for Science and Education serves as chairperson of the Committee.

USDA agencies providing assistance in the preparation of this report were: Agricultural Cooperative Service (ACS), Agricultural Marketing Service (AMS), Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Economic Research Service (ERS), Extension Service (ES), Forest Service (FS), Human Nutrition Information Service (HNIS), National Agricultural Library (NAL), Office of International Cooperation and Development (OICD), Office of Transportation (OT), and Statistical Reporting Service (SRS).

Copies of this report can be obtained from:

Executive Secretary
Research and Education Committee
USDA, Room 404, Building 005, BARC-W
Beltsville, Maryland 20705

Nation's Largest Industry

The food and agricultural sciences provide the research and education programs which serve the Nation's largest industry. Agriculture and forestry combined are responsible for approximately 25 percent of gross national product and employment in the United States. These sectors also provided $19.1 billion in export trade surpluses in Fiscal Year (FY) 1984.

USDA Funding

Federal funding, through the U.S. Department of Agriculture, for research and education programs in support of agriculture and forestry have increased significantly over recent years in current dollars - from $722 million in FY 1977 to $1,320 million (estimated) for FY 1985. In constant 1977 dollars, however, total funding actually declined, from $772 million to $754 million. USDA funding for research rose over the period in constant 1977 dollars, from $511 million to $547 million (estimated) in FY 1985. Funding for education decreased, from $262 million to $207 million.

Other Funding

Other Federal agencies, industry, and State sources provide significant funding for research and education programs related to agriculture and forestry. In FY 1984, they spent an estimated $3.9 billion, about three times the level of USDA funding that year.

Research Results

By definition, research and education are long range, and year-to-year funding cannot be related directly to the results obtained in any one year. Yet in each year, long-term projects produce results. Selected examples of major accomplishments by USDA research and education agencies in FY 1984 are as follows:

Biotechnology Research Center Established

The Agricultural Research Service, the University of California/Berkeley, and the California Agricultural Experiment Station have jointly established the Plant Gene Expression Center (PGEC) at Albany, California. Research at the PGEC will focus on identifying the mechanisms that turn a given gene's activity on or off. PGEC's mission is to convert fundamental research into new genetics tools to improve the yield and quality of crop plants and to render them resistant to insects, diseases, and environmental stresses.

Farm Financial Management

Extension financial management education programs assist producers in many States in preparing and analyzing cash flow and other financial statements, developing improved plans for organizing farm enterprises, and making effective marketing decisions. Intensive workshops, computerized financial management techniques, and other methods of intensive assistance are used with individual farmers to help them analyze their situation and make appropriate decisions.

Legislatures in North Dakota, Nebraska, and Iowa funded expansion of individual assistance for these farmers. A pilot program to provide assistance on a fee basis was funded with money from Nebraska and from Extension Service-USDA.

Food Relief

The Agency for International Development (AID) has requested that the Office of Transportation assist in providing a tracking system for food shipments from the United States to African countries. The effort seeks to coordinate food delivery to combat famine in Ethiopia and Sudan.

Work Continued Toward Boosting Export Sales

In the Agricultural Cooperative Service research and promotion continued toward helping co-ops improve and strengthen their capabilities in international trade. Marketing opportunities were assessed for grain and oilseeds with Czechoslovakia, the German Democratic Republic, Hungary, and Poland. U.S. exports to these countries totaled $497 million in 1982, representing 2.4 percent of total U.S. agricultural exports. A buyer's guide to dealing direct with grain co-ops was updated and guides on pulses and fruits, vegetables, and nuts were developed.

Research to Develop Methodology for Using Satellite Data

In 1984, Landsat multispectral scanner data were used with Statistical Reporting Service ground-gathered data to calculate improved crop estimates at the State and county level in seven Midwestern States. Data were obtained from both Landsat 4 and 5 which resulted in much better coverage in the major producing agricultural areas.

Rapid Diagnosis of Diseases

Cooperative State Research Service supported research in 18 States, including extensive work at the University of California, that centered on the development of new diagnostic procedures for animal diseases which are reliable, fast, and relatively inexpensive. These tests--called enzyme-linked immuno assays (ELISA)--are being used for the rapid detection of viral, bacterial, and parasitic agents such as infectious bovine rhinotracheitis, bovine viral diarrhea, infectious bronchitis (chickens), and cysticercosis. The general availability of these procedures has made it possible to detect the causative agents of disease much more rapidly and more simply, resulting in more efficient treatment of the diseases.

Applications of Biotechnology to Forest Products

Researchers at the Forest Service's Forest Products Laboratory have discovered a lignin-degrading enzyme. The discovery of this enzyme opens the possibility for many applications of biotechnology in wood processing, biopulping, biobleaching, conversion of lignin to useful chemicals, and cleaning up noxious lignin wastes from pulp and mills.

International Collection, Delivery of Aquaculture Documents	The National Agricultural Library (NAL), in a project coordinated by the Food and Agriculture Organization of the United Nations (FAO), began working with the National Oceanic and Atmospheric Administration (NOAA) and the Aquatic Sciences and Fisheries Information System (ASFIS) to provide document delivery services for aquaculture materials collected worldwide, processed by ASFIS, and incorporated into the NAL collection. Also, the library recently acquired the entire aquaculture microfiche collection of the Virginia Institute of Marine Science (VIMS) as part of a cooperative indexing agreement with VIMS.
Aseptic Processing and Packaging of Food	Utilizing funds provided by the Cooperative State Research Service and the State of Indiana, food scientists at Purdue University, working in concert with industry, have been among the leaders in developing aseptic bulk food storage processing as well as in determining product sterility, shelflife and methods for packaging and transporting aseptically processed food products. This process saves energy and improves flavor.
Nutrient Data Bank Modernized	The Human Nutrition Information Service (HNIS) modernized its Nutrient Data Bank system to help provide more efficiently accurate and up-to-date information on the nutrient composition of all foods important in American diets. Comprehensive reference tables on the nutrient composition of vegetables and of nuts and seeds were published. The content of about 25 nutrients in the thousands of foods Americans eat were determined and entered into a data file for use in appraising diets reported in the Continuing Survey of Food Intakes by Individuals.
Drip Irrigation May Be Profitable	An Economic Research Service study of drip irrigation on cotton in Arizona indicates that drip irrigation reduces water application requirements 30 to 50 percent, making it potentially more profitable than conventional furrow irrigation. Drip irrigation results in no significant decrease in yields, and in some tests has sharply increased yields.
Wholesale Market Facilities	Studies have been completed by the Agricultural Marketing Service for new wholesale food distribution centers for southern New Jersey and Raleigh, North Carolina. With surveys of 230 firms, data collection has been completed and analyses begun for determining the need for improved wholesale distribution facilities for San Diego, California.
First Fungus for Biocontrol Patented	The Agricultural Research Service has been issued a patent on its discovery and development of a fungus that destroys disease-causing fungi in crops. The beneficial fungus, Trichoderma, was obtained from soil, developed to improve its effectiveness, and shown to control root-rotting diseases of

potatoes and vegetables in the field. The patent is the first on biological control of plant diseases and it has been licensed by a private company.

Embryo Transfer

Research, supported by the Office of International Development, in Yugoslavia and Pakistan will provide information on the transmissibility of livestock diseases by embryo transfer. Preliminary research has shown that certain infectious diseases are not likely to be transmitted by embryos. If this proves true, breeders can exchange bloodlines without danger of also exchanging diseases. Embryo transfer is more efficient than artifical insemination for upgrading livestock in developing countries. Not only is the transferred embryo free of diseases from its biological parents but, also, the surrogate mother provides acquired immunity to native diseases at birth. The results from this research will enable quarantine officials to draft new rules for international trade in livestock embryos.

Future Research Emphasis

Departmental, Joint Council, and Users Advisory Board recommendations for areas of research emphasis in the future include: market development, economics, basic biotechnology, soil erosion control, water management, human nutrition, and increased efficiency of production.

Extension's Future Emphasis

Program emphasis for Extension in the future includes financial management; food and fiber marketing management; management and conservation of soil, water, forest, and rangeland; and human nutrition and health.

CONTENTS

FEDERAL, STATE, AND PRIVATE INDUSTRY SUPPORT FOR THE FOOD AND AGRICULTURAL SCIENCES

DEPARTMENT OF AGRICULTURE

The U.S. Department of Agriculture's research and education (R&E) agencies supported food and agriculture research, extension, and teaching programs funded at approximately $1,237 million in FY 1984, up 3.3 percent from FY 1983. These programs were centered in the Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Extension Service (ES), National Agricultural Library (NAL), Forest Service (FS), and Economic Research Service (ERS). Other agencies having research and education activities include the Agricultural Cooperative Service (ACS), Agricultural Marketing Service (AMS), Human Nutrition Information Service (HNIS), Office of International Cooperation and Development (OICD), Office of Transportation (OT), Statistical Reporting Service (SRS), and Federal Grain Inspection Service (FGIS). USDA research and education program funding for Fiscal Year 1985 is estimated to be $1,321 million (table 1).

The research and education (R&E) programs of the Department are complementary and mutually supportive in providing new knowledge, technology, and information on food, agriculture, and forestry issues vital to producers, marketing firms, consumers, and action agencies. The results of these efforts affect the total economy of the United States and millions of consumers here and abroad. Including production, processing, and marketing, the agriculture and forestry sectors account for approximately 25 percent of gross national product and 25 percent of employment in the United States. These sectors also provided $19.1 billion in export trade surpluses in FY 1984, up from $18.4 billion in FY 1983. This helped to offset huge and increasing trade deficits in other categories.

USDA research programs address national issues in production efficiency, export markets, marketing efficiency, natural resources management and conservation, human and community development, and human nutrition. Research programs financed by the Department encompassing this complex array of issues, represented 2.0 percent of the FY 1984 Federal research funding of $45.3 billion.

The Secretary of Agriculture has identified research and extension as one of his five major goals. The research and education programs provide major underpinnings for the remaining goals of the Secretary which are (1) a strong, healthy agricultural economy, (2) food and fiber for peace and economic stability, (3) resource conservation, and (4) support for State and local governments.

Over the past 8 years, funding for USDA Research and Education programs has grown significantly in current dollars - from $772

million in FY 1977 to $1,321 million for FY 1985 (table 1 and fig. 1). However, the gain in current dollars for research and education was more than offset by inflation over the period. In constant 1977 dollars, funding actually declined 2.3 percent, from 772.3 million in FY 1977 to $755 million in FY 1985 (table 2).

The trend in overall R&E funding in constant dollars over the period peaked in 1978 and has trended slightly downward since that time. Funding for research exhibited much the same trend. USDA funding for research in constant dollars peaked in 1978 and remained below that level to 1985. Funding for education in constant dollars declined in all years from 1977 to date (fig. 2).

Differences in funding were apparent among the R&E agencies. Five agencies operating R&E programs over the 1977-85 period had funding increases more than sufficient to cover inflation; three maintained a level of funding sufficient to match inflation; and five did not receive funding increases large enough to cover inflation (table 3).[1]

[1]CSRS received funding increases for research programs; however, the Agency did not receive large enough increases to cover inflation for its educational programs.

Table 1.—U.S. Department of Agriculture: Appropriations for research and education FY 1977-85

(Million dollars)

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985 approp.
RESEARCH									
Agricultural Research Service[1]	258.5	313.9	328.0	358.0	404.1	423.2	451.9	469.0	489.0
Coop. State Res. Service[2]									
Hatch Act formula	98.0	109.1	109.1	118.6	128.6	141.1	147.2	152.3	156.5
Cooperative Forestry	8.2	9.5	9.5	10.0	10.8	12.0	12.4	12.7	13.1
1890 Colleges & Tuskegee	13.5	14.1	16.4	17.8	19.3	21.5	21.8	22.8	23.5
Special Research Grants	6.3	7.2	16.3	15.2	18.2	23.1	27.8	26.5	28.5
Competitive Research Grants	0.0	15.0	15.0	15.5	16.0	16.3	17.0	17.0	46.0
Rural Development Research	1.5	1.5	1.5	1.5	0.0	0.0	0.0	0.0	0.0
Animal Health & Disease	0.0	0.0	5.0	6.0	6.5	5.8	5.8	5.8	5.8
Direct Federal Admin.	1.5	1.5	1.5	1.3	1.3	0.8	0.3	0.6	1.0
Total, CSRS[2]	129.0	157.9	174.3	185.9	200.7	220.6	232.3	237.7	274.3
Statistical Reporting Service	4.7	5.0	5.4	5.0	7.5	7.0	7.6	8.2	8.3
Economic Research Service	24.5	26.0	28.2	26.1	39.5	39.4	38.8	44.3	46.6
Human Nutrition Info. Service	5.4	6.1	6.6	7.1	8.2	8.5	7.7	6.1	7.5
Agricultural Coop. Service	1.3	1.8	2.0	1.6	1.8	1.7	2.2	2.2	2.2
Agricultural Marketing Service	0.9	0.9	1.0	1.3	1.4	1.5	1.5	1.6	1.6
Office of Transportation	0.6	0.6	0.7	0.8	0.9	1.0	0.8	0.8	0.5
Office of Int. Coop. & Dev.	8.3	6.6	6.6	5.3	5.0	0.7	5.5	5.3	5.3
Forest Service	76.9	90.6	95.0	95.9	108.4	112.1	107.7	108.7	121.0
Federal Grain Inspection Service	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	1.4
Total, Research	510.5	609.8	648.2	687.5	778.0	816.3	856.6	884.6	957.7
EDUCATION:									
Extension Service									
Smith-Lever 3(b&c) Formula	168.2	176.0	179.8	189.3	205.4	219.4	230.4	235.0	241.5
Other Extension Programs	67.6	75.0	77.5	78.2	80.7	90.0	92.8	93.8	96.3
Direct Federal Admin.	6.1	6.5	6.5	6.5	6.1	6.3	5.4	5.5	5.9
Total, Extension Service	241.9	257.5	263.8	274.0	292.2	315.7	328.6	334.3	343.7
Coop. State Research Service									
Bankhead Jones	11.5	11.5	11.5	11.5	11.5	0.0	0.0	0.0	0.0
Morrill Nelson Act	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8
Competitive Fellowship Grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	3.0
1890 Colleges Grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Total, CSRS	14.2	14.2	14.2	14.2	14.2	2.8	2.8	7.8	7.8
National Agricultural Library	5.7	6.6	7.0	7.3	8.2	8.2	9.1	10.4	11.5
Total, Education	261.8	278.3	285.0	295.5	314.6	326.7	340.5	352.5	363.0
Total, Research & Education	772.3	888.1	933.2	983.0	1,092.6	1,143.0	1,197.1	1,237.1	1,320.7

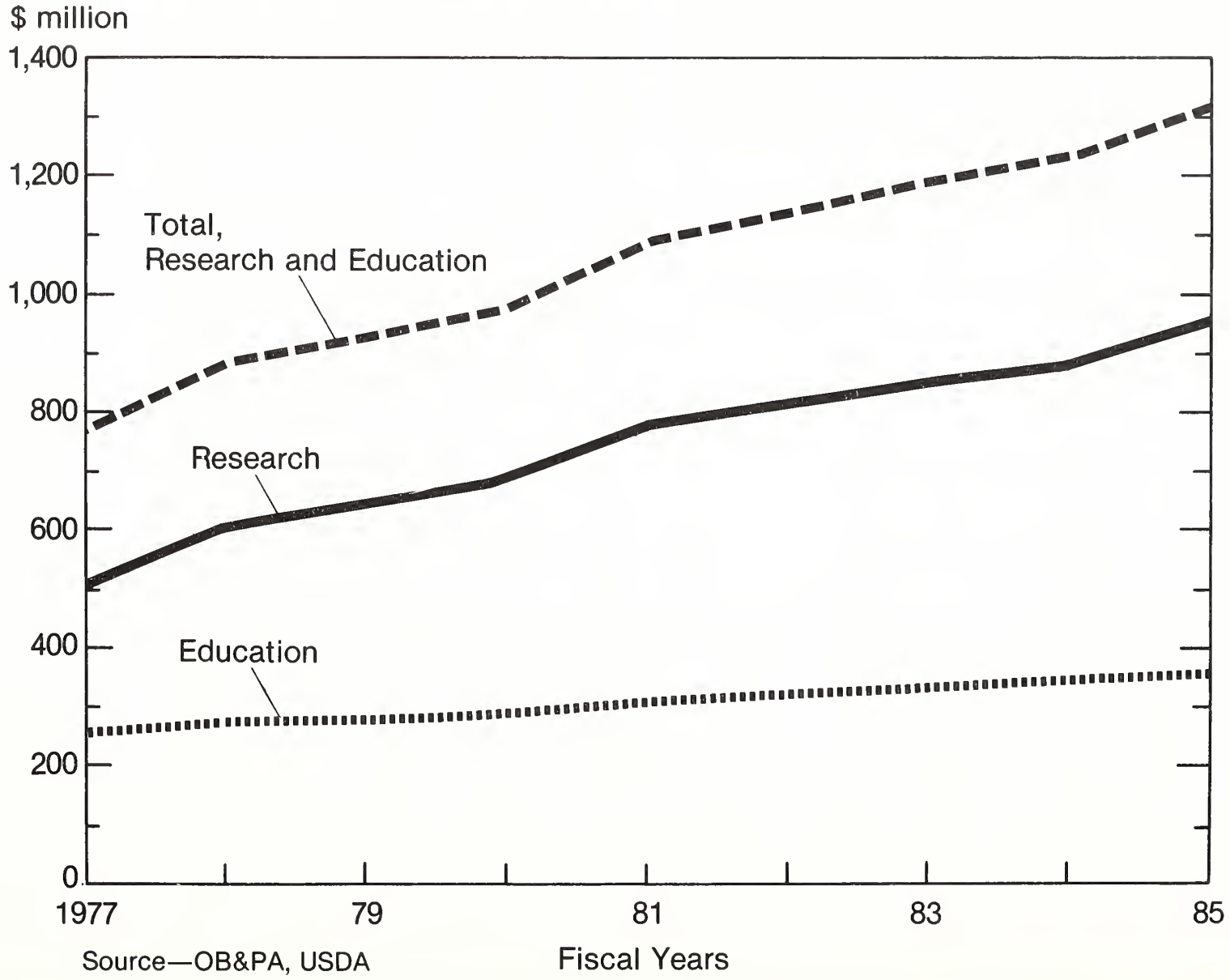
[1]Excludes ARS construction funding which has been (in millions of dollars): $0.4 ('77), $9.0 ('78), $36.7 ('79), $0 ('80), $12.1 ('81), $8.6 ('82), $4.9 ('83), $77.9 ('84), $23.0 ('85).

[2]Excludes 1890 Colleges and Tuskegee Research Facilities, which is $10.0 million annually from FY 83 through FY 85.

Source: OB&PA-USDA.

Figure 1.

USDA Budget Appropriations for Research and Education Programs (Current Dollars)



Source—OB&PA, USDA

Table 2.—U.S. Department of Agriculture: Appropriations for research and education in constant 1977 dollars, FY 1977-85

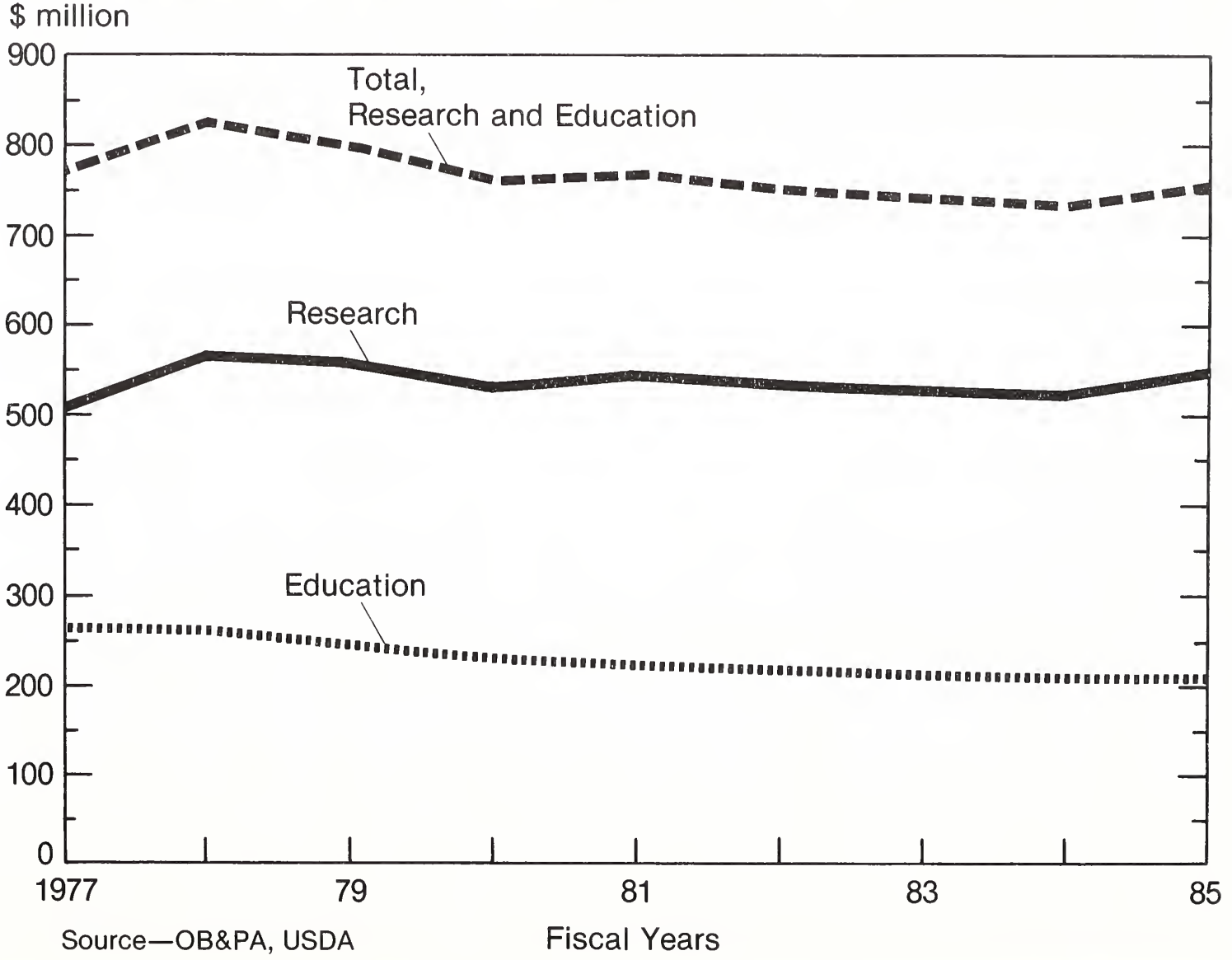
(Million dollars)

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985 approp.
Inflation rate		7.5%	8.3%	11.0%	9.9%	6.9%	5.7%	5.0%	3.7%
GNP Deflator for Govt. Purchases Index: (1972 = 100)	146.3	157.3	170.4	189.2	207.9	222.5	235.2	246.9	256.1
RESEARCH									
Agricultural Research Service	258.5	291.9	281.6	276.8	284.4	278.3	281.1	277.9	279.4
Coop. State Res. Service									
Hatch Act formula	98.0	101.5	93.7	91.7	90.5	92.8	91.6	90.2	89.4
Cooperative Forestry	8.2	8.8	8.2	7.7	7.6	7.9	7.7	7.5	7.5
1890 Colleges & Tuskegee	13.5	13.1	14.1	13.8	13.6	14.1	13.6	13.5	13.4
Special Research Grants	6.3	6.7	14.0	11.8	12.8	15.2	17.3	15.7	16.3
Competitive Research Grants	0.0	14.0	12.9	12.0	11.3	10.7	10.6	10.1	26.3
Rural Development Research	1.5	1.4	1.3	1.2	0.0	0.0	0.0	0.0	0.0
Animal Health & Disease	0.0	0.0	4.3	4.6	4.6	3.8	3.6	3.4	3.3
Direct Federal Admin.	1.5	1.4	1.3	1.0	0.9	0.5	0.2	0.4	0.6
Total, CSRS	129.0	146.9	149.6	143.7	141.2	145.1	144.5	140.8	156.7
Statistical Reporting Service	4.7	4.7	4.6	3.9	5.3	4.6	4.7	4.9	4.7
Economic Research Service	24.5	24.2	24.2	20.2	27.8	25.9	24.1	26.2	26.6
Human Nutrition Info. Service	5.4	5.7	5.7	5.5	5.8	5.6	4.8	3.6	4.3
Agricultural Coop. Service	1.3	1.7	1.7	1.2	1.3	1.1	1.4	1.3	1.3
Agricultural Marketing Service	0.9	0.8	0.9	1.0	1.0	1.0	0.9	0.9	0.9
Office of Transportation	0.6	0.6	0.6	0.6	0.6	0.7	0.5	0.5	0.3
Office of Int. Coop. & Dev.	8.3	6.1	5.7	4.1	3.5	0.5	3.4	3.1	3.0
Forest Service	76.9	84.3	81.6	74.2	76.3	73.7	67.0	64.4	69.1
Federal Grain Inspection Service	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.8
Total, Research	510.5	567.2	556.5	531.6	547.5	536.7	532.9	524.1	547.1
EDUCATION:									
Extension Service									
Smith-Lever 3(b&c) Formula	168.2	163.7	154.4	146.4	144.5	144.3	143.3	139.2	138.0
Other Extension Programs	67.6	69.8	66.5	60.5	56.8	59.2	57.7	55.6	55.0
Direct Federal Admin.	6.1	6.0	5.6	5.0	4.3	4.1	3.4	3.3	3.4
Total, Extension Service	241.9	239.5	226.5	211.9	205.6	207.6	204.4	198.1	196.4
Coop. State Research Service									
Bankhead Jones	11.5	10.7	9.9	8.9	8.1	0.0	0.0	0.0	0.0
Morrill Nelson Act	2.7	2.5	2.3	2.1	1.9	1.8	1.7	1.7	1.6
Competitive Fellowship Grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.7
1890 Colleges Grants	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Total, CSRS	14.2	13.2	12.2	11.0	10.0	1.8	1.7	4.6	4.5
National Agricultural Library	5.7	6.1	6.0	5.6	5.8	5.4	5.7	6.2	6.5
Total, Education	261.8	258.8	244.7	228.5	221.4	214.8	211.8	208.9	207.4
Total, Research & Education	772.3	826.0	801.2	760.1	768.9	751.6	744.7	732.9	754.5

Source: OB&PA-USDA.

Figure 2.

USDA Budget Appropriations for Research and Education Programs (1977 Constant Dollars)



Source—OB&PA, USDA

Table 3.--U.S. Department of Agriculture: Percentage changes in appropriations for research and education programs, by Agency, from FY 1977 to 1985, in constant 1977 and current dollars

Agency	Constant 1977 dollars	Current dollars
	(Percent)	
Research		
Agricultural Research Service	+8.1	+89.2
Cooperative State Research Service	+21.5	+112.6
Human Nutrition Information Service	-20.3	+38.9
Economic Research Service	+8.6	+90.2
Statistical Reporting Service	0	+76.6
Agricultural Cooperative Service	0	+69.2
Agricultural Marketing Service	0	+77.7
Office of Transportation	-50.0	-16.7
Office of Int'l. Cooperation & Dev.	-63.8	-36.1
Forest Service	-10.1	+44.1
Federal Grain Inspection Service	+100.0	+250.0
Total, Research	+7.2	+87.6
Education		
Extension Service	-18.0	+42.8
Cooperative State Research Service	-68.3	-45.0
National Agricultural Library	+14.0	+101.8
Total, Education	-20.8	+38.6
Total, USDA Research and Education	-2.3	+71.0

STATE SUPPORT

State support for research, extension, and higher education for the food, fiber, and forestry system approximately equals that of the Federal contributions--about $1.3 billion. Combined Federal and State funds support approximately 11,000 scientists and 17,000 extension personnel who are the formulators and extenders of knowledge needed by the Nation's largest industry. Public investment in food and agriculture research and education has consistently provided annual returns of 30 percent or more.

State support for the food and agricultural sciences is provided primarily through the land-grant institutions (1862, 1890, forestry schools, and Tuskegee Institute) and includes funds for research, extension, and higher education. However, there are an estimated 50 State-supported, non-land-grant institutions that also have agricultural programs. These programs are primarily devoted to higher education.

PRIVATE INDUSTRY R&D

A recent (March 1985) OTA report entitled "Technology, Public Policy, and the Changing Structure of American Agriculture" states that "the current magnitude of private sector commitment (to agricultural R&D) is largely unknown." However, a report by the Agricultural Research Institute (ARI) on private industry R&D in agriculture is just being completed. The results of industry surveys which are the basis for this report revealed that over 400 companies spent $1.3 billion on agricultural R&D per year. While not all inclusive, this is one indication of the level of support for research by agribusiness.

AGRICULTURAL RESEARCH SERVICE (ARS)

Biotechnology Research Center Established

Center established for research in biotechnology. The Agricultural Research Service, the University of California/Berkeley, and the California Agricultural Experiment Station have jointly established the Plant Gene Expression Center (PGEC) at Albany, California. Research at the PGEC will focus on identifying the mechanisms that turn a given gene's activity on or off. The PGEC will assemble experts in the various facets of the field to unravel the complex biology of plant gene expression, stimulate and coordinate complementary research among public and private research groups, and ensure that the knowledge is quickly transferred to the farm. PGEC's mission is to convert fundamental research into new genetics tools to improve the yield and quality of crop plants and to render them resistant to insects, diseases, and environmental stresses.

Germplasm Network

A Germplasm Resources Information Network (GRIN) is now available to the scientific community. Information regarding the location, characteristics, and availability of germplasm accessions within the U.S. National Plant Germplasm System is now available to all scientists through GRIN. This computerized database management system serves two broad groups of "information users": (1) the suppliers (such as curators and staff of the Plant Introduction Stations) who acquire, maintain, and distribute germplasm and data; and (2) those who use the germplasm resources and data. These include public and private plant breeders as well as other interested scientists and researchers.

40 USDA Patents Licensed

During 1984, 40 public patent licenses were granted on U.S. Department of Agriculture research. Of the total, 19 licenses were granted on inventions based upon Agricultural Research Service projects. Eleven licenses were granted on an exclusive/coexclusive basis to public firms who pledged a sizable capital investment to manufacture a variety of agricultural products for public sale. Also, through the combined efforts of ARS activities in patents, technology transfer, and information releases, inquiries regarding patent licenses increased nearly 70 percent in 1984 compared with a year earlier.

Computer Network Speeds Technology Transfer

In 1984, the Agricultural Research Service and the Extension Service implemented a system to transfer technology developed by ARS researchers directly to State Cooperative Extension Services specialists via an interagency computer network called Technet. A successful pilot test was conducted wherein nearly 900 brief descriptions of new ARS research findings were made available to SCES in South Carolina, Pennsylvania, Missouri, North Dakota,

Arizona, and Florida up to one year earlier than would have been possible through the usual publications route. A critique by pilot test participants in December 1984 resulted in recommendations that all SCES be provided access to the network and also that research results from other USDA agencies and universities be added to the system.

No-Till in Cotton Successful

No-till reduces soil erosion and increases yield of cotton. After 11 years of experimental cropping in Oxford, Mississippi, conservation tillage system for cotton compared with conventional tillage reduced erosion by more than 70 percent, and increased seed cotton yield by 20 percent. These conservation tillage practices represent a significant step in helping to reduce soil loss to the tolerable levels established by the Soil Conservation Service (SCS).

Computerized Irrigation System

Computer program developed for border-irrigation system. A computer program has been developed to guide farmers in managing irrigation systems. The program solves the border irrigation problem for systems of different levels of complexity and cost. It handles a variable-in-flow hydrograph and a variable bottom slope, and it provides a variety of outputs to meet the user's needs. The development and documentation of this program represent a significant advancement in the state of the art in water management for surface irrigation.

First Hybrid Wheatgrass Developed

Improved crested wheatgrass increases productivity of semiarid rangelands. The first interspecific hybrid of crested wheatgrass -- an important forage crop in the Western United States -- has been released. The new cultivar, Hycrest, was selected for adaptation to the environmental stresses encountered on Intermountain rangelands. The hybrid shows superiority to other presently available cultivars, particularly in terms of productivity under semiarid conditions. The new hybrid is expected to make a major impact in the improvement of rangelands in the sagebrush ecosystem, and good stands have also been obtained in drought areas that receive less than 10 inches of annual precipitation.

Nematode Resistant Soybeans

New soybean varieties resistant to soybean cyst nematode. The soybean cyst nematode causes production losses estimated at $150 million annually. Three new soybean varieties have now been released for commercial production. Two of these, CN 210 and

CN 290, are resistant to race 3 of the soybean cyst nematode. Because of their resistance and early maturity, they extend the production area about 150 miles farther north on cyst-infested fields in the central Midwest. The third variety, Epps, has been released for production in the South, and it is resistant to races 3 and 4 of the soybean cyst nematode, soybean mosaic virus, and phytophthora rot. Epps has the potential to increase yields by as much as 10 bushels per acre, or $60 per acre at 1984 soybean prices.

Tissue Culture of Apple Trees

Self-rooted apple trees created by tissue culture for planting high-density orchards. Conventional grafting is too expensive for high-density orchards, which are desirable for the economic production of fruit crops. A new method has been developed for efficiently rooting shoots of apple in sterile cultures. The method, which consists of a greatly simplified culture medium with dark incubation at 30°C, results in 80-90 percent rooting. Self-rooted trees created by tissue culture can be planted economically at the rate of 700 to 1,000 trees per acre. The trees are being distributed to experiment stations for replicated field trials to determine their productivity in comparison with conventionally grafted trees.

$25 Million More Income From Rice

Improved management practices for rice increase farm profits $25 million. New systems are now available for improved rice production. Preplanting, preemergence, and postemergence application of individual herbicides, herbicide mixtures, plant pathogens, water management, fertilizer practices, and other integrated weed management practices have increased rice yields by 10 percent and eliminated the need for two herbicide applications on 500,000 acres of rice in the South. The increased grain yield and reduced weed control costs have increased net profits of rice growers by $25 million annually.

Biocontrol of Wheat Diseases

Effective biological control of root diseases of wheat. The application of beneficial bacteria as seed treatments has proved to be a new and ecologically sound approach for controlling root diseases of wheat. Tests conducted in Washington State demonstrated that these beneficial bacteria would enhance wheat growth. Four different strains, when applied as seed treatments, increased the yield by 26, 20, 10, and 2 percent, respectively. The growth response appears to have resulted from the suppression of pythium root rot.

First Fungus for Biocontrol

Patent granted to ARS for developing the first biocontrol fungus against diseases. The ARS has been issued a patent on its discovery and development of a fungus that destroys disease-causing fungi in crops. The beneficial fungus, Trichoderma, was obtained from soil, developed to improve its

effectiveness, and shown to control root rotting diseases of potatoes and vegetables in the field. The patent is the first on biological control of plant diseases and has been purchased by a private company.

Quick Identification of Citrus Canker

New testing methods developed by ARS led to quick identification of the new canker disease of citrus. The ARS contributed significantly to solving the citrus canker crisis in Florida. The rapid and accurate diagnosis of this disease by ARS was made possible as a result of research already underway at Beltsville. The sophisticated tests not only identified the disease as canker, but also as a new strain of the bacterium. Tests were so thorough and conclusive that eradication steps were initiated without delay.

Sex Selection Closer to Reality

Sorting of X and Y chromosome-bearing chinchilla spermatozoa. Presently, it is not possible to control the prenatal sex ratio in livestock as a means of increasing flexibility and efficiency in herd management. In studies with laboratory chinchillas, scientists have successfully separated the animals' X and Y chromosome-bearing spermatozoa into two populations based on their DNA content. This achievement moves science closer toward the ability to verify the sex of the X and Y sperm populations and to develop other biochemical markers for discriminating between the two populations. This accomplishment provides important new knowledge in the study of animals used for food production.

Poultry Losses Reduced

Controlled acclimatization of poultry reduces heat prostration losses. Heat prostration decreases performance or causes death in poultry production units and results in higher prices to consumers. The optimum growing temperature for converting feed to broiler meat is 21°C. In most U.S. production areas the ambient temperature exceeds 21°C for at least 3 months of the year. No mortality occurred in broiler chickens acclimatized at a 24-hour linear temperature cycle of 24° to 35° to 24°C before temperature stress (40.6°C) was imposed. A controlled acclimatization system can significantly improve the efficiency of poultry production systems.

New Chemical Sterilizes Fire Ants

Evaluation of avermectin against the imported fire ant. Avermectin, a natural product derived from soil micro-organisms, was shown to be very effective in sterilizing laboratory and field colonies of the red imported fire ant. In field tests, avermectin baits applied as low as 50 milligrams of active ingredient per acre gave excellent control of natural populations of fire ants. Thus, another chemical tool has been shown to offer control of the imported fire ant.

Feeder Calves Do Well on Yeast

Effect of adding yeast culture to the receiving ration of stressed stocker calves. Stressed calves often have lower feed intakes than nonstressed calves. A lack of adequate daily nutrient intake is a negative influence on viral and bacterial resistance. Thus, quick recovery of optimum intake after a period of stress would increase the calf's natural resistance. Yeast culture added at the rate of 1 or 2 percent to the poststress diet of feeder calves tended to increase feed intake and weight gain and to effect better feed conversion than for calves not receiving yeast.

Cause of Pig Diarrhea Discovered

New research tools developed for studying diarrhea in baby pigs. With the advent of confinement rearing practices in the swine industry, the problem of baby pig diarrhea has worsened. An important disease-causing agent, the coccidian Isospora suis, has recently been discovered by ARS scientists. An in vitro cultivation system was developed to aid researchers in devising control procedures for this disease. A baby pig model has also been developed for studying the disease process in infected baby pigs. These research tools will greatly enhance progress toward the development of an effective method for controlling this disease.

New Technology for Tanning Hides

Rapid new hide processing method reduces pollution and lowers costs. More than half of U.S. cattle hides are exported for leather manufacture in other countries where labor costs are lower and environmental regulations less restrictive. To counter this trend, ARS scientists have developed a radically new approach to hide processing -- Continuous Automatic Beamhouse Processing -- that reduces pollution and automates hide handling. Industrial interest has been shown in the Automated Beamhouse and could lead to the first tanning installation of the new technology.

Steam Destroys Salmonella in Poultry Feed

Steam conditioning to destroy salmonellae in poultry feed. Poultry feed is considered one source of salmonellae, a bacteria which infects the live bird and contaminates processed poultry carcasses. Experiments confirm that increasing the steam flow during feed pelleting can destroy the bacteria in the feed. An experimental poultry feed steam conditioner has been designed, constructed, tested, and found to eliminate salmonellae at the conditioner stage of feed pelleting. Chick-feeding studies indicated that the process does not affect the nutritional quality of conditioned pelleted feed. This experimental conditioner could prove to be a useful modification for existing pellet mills to provide a greater margin of safety for roduction of salmonella-free poultry feed.

Alternatives to EDB

Alternatives to ethylene dibromide (EDB) developed. The use of EDB as a quarantine fumigant against insect pests was banned in September 1984, except for imported mangoes and for the export of grapefruit and papaya. Also, EDB can only be used for grapefruit export to January 31 of each year. Because of these factors, it was essential that acceptable alternatives be developed. Cooperative research is being conducted to develop acceptable treatments for fruit flies that involve the use of cold temperatures or methyl bromide for citrus as well as the "double dip" treatment for papaya. The "double dip" method is the first to be developed that encompasses a specific, sequential treatment that does not require the use of chemicals. This method combines immersion of papayas in water at 108°F for 40 minutes (for preheating); a second immersion in water at 120°F for 20 minutes; and finally the selection of papayas that are one-quarter ripe -- a condition in which the fruit contains a chemical that prevents development of fruit flies. Methyl bromide and the "double dip" method, both approved for use in the U.S. by Federal and State regulatory agencies, have excellent potential for approval as quarantine treatments, thus maintaining U.S. exports to Japan of citrus and papaya valued at more than $120 million annually.

Peanut Quality Improved

Improving the quality and marketability of U.S. peanuts. Foreign material (such as glass and rocks) in U.S.-grown edible peanuts hinders both domestic and foreign markets. The problem occurs far more often from the use of peanuts produced by U.S. mechanization than from those grown in countries still dependent on hand labor. Scientists have devised a means of improving the air separation process by which peanuts are cleaned prior to shelling. The installation of a specially designed air stratification section and louvered separation chamber would ensure that foreign material is concentrated for easy removal and not trapped with the peanuts. Application of this innovation should significantly reduce the number of complaints and lawsuits and enhance the worldwide marketability of U.S. peanuts.

Diet Control and Exercise Benefit Elderly

Diet control and exercise can reduce rate of muscle protein breakdown in the elderly. It has been shown that physical work capacity, muscle mass, and rates of protein turnover are reduced with age. The rate of albumin formation is controlled at a lower set point, and muscle makes a reduced contribution to whole body protein turnover in older as compared with young adults. Whole body leucine metabolism examined while subjects were in the postabsorptive state did not reveal major differences between young and older adult subjects. However, it was found that the rate of breakdown of muscle protein is under the control of diet and of hormones. Preliminary results of a

3-month training program for elderly men and women indicate increases in functional capacity and reductions in percent body fat. These findings may have significance for the preservation of muscle mass during aging.

Computer Model Aids Farmers in Reducing Costs

COFARM, a computer model for efficient soil and crop management. Farmers, extension specialists, and researchers can use COFARM for organizing and storing data for individual fields, soils, and crops. The model can simulate the effects of different management practices and help make decisions on fertilization, tillage, drainage, residue management, and other key activities for producing crops efficiently and controlling soil erosion. The computer program is user friendly and operates using a remote terminal or microcomputer. This model is one example of a number of management models that are becoming available for reducing production costs and conserving natural resources on the Nation's crop and rangelands. Some of these models are being tested for making crop production forecasts here and in foreign countries.

Reviews and Regional Research

CSRS conducted 94 special reviews in the State Agricultural Experiment Station System, 1890 Institutions, and Forestry Schools using peer panels to evaluate research productivity, program direction, and future research opportunities. State Agricultural Experiment Station Administrators, Administrative-Technical Representatives, and 1890 Directors met in regional and national meetings to coordinate research administration and to focus on emerging research needs and direction. In addition, scientists within CSRS met with 230 regional-technical committees and 241 regional coordinating committees to coordinate interstate and interregional research on problems of regional and national concern.

National Research Planning and Implementation Activities

CSRS supported and sponsored 14 conferences and symposia during Fiscal Year 1984. These conferences ranged from a survey of research methods to the molecular basis of plant diseases and included (1) a major international conference to review the theory, current research, and strategies to deal with the spread of beneficial and harmful biotic agents; the movement and dispersal of such living organisms impact markedly on the ecology, epidemiology, population genetics, ecological stability of beneficial and pestiferous organisms in the environment; (2) an interagency supported symposium/workshop sponsored by the National Academy of Sciences to address ecological, evolutionary, and biochemical/biotechnological strategies to cope with the increasing prevalence of pests resistant to currently used pesticides; and (3) the national minor-use pesticide registration program expanded to include research required to clear minor-use animal drugs and biological agents. Past coordination with the pesticide industry and the Environmental Protection Agency has been increased to include the pharmaceutical industry and the Food and Drug Administration.

Hatch Act Research

Control Over Available Soil Nitrogen. Researchers at the Vermont Agricultural Experiment Station have developed a promising soil test for available nitrogen. By using this test, farmers should have adequate information to prevent using either too much nitrogen fertilizer resulting in possible ground water pollution and extra cost, or too little nitrogen fertilizer which would result in lower yields and reduced profit.

Control Over Growth Hormone in Animal Production. Scientists at Cornell University have demonstrated that daily doses of highly purified and recombinant growth hormone result in a 10- to 40-percent increase in milk yield in high-producing dairy cows. The increases are dose-dependent. No changes in digestibility of dietary components occur, thus the effects of

growth hormone appear to be exclusively on the post-absorptive utilization of nutrients. Blood concentrations of most metabolites, minerals, and other hormones are unaltered during the treatment period. Efforts to identify mechanisms of growth hormone action will continue.

Engineering System for Field Crops Seed Harvesting. This research has resulted in the development of an air-jet lifter guard for headers of combines which recovers alfalfa seed shattered during the gathering/cutting of the seed crop. Studies showed an average seeds savings of 88 pounds per acre or an average increase of $960 in daily income, assuming a seed value of $1.00 per pound. The air-jet lifter, now produced commercially, costs about $9,400. Thus, only 10 harvesting days are needed to return the cost of the attachment.

Nutrition Linked to Prevention of Mastitis. Ohio scientists have discovered that vitamin E and selenium are important in protecting the mammary gland against infectious organisms, with the greatest protection resulting from treatment during the cow's dry period. This is the first documentation linking nutrition to mastitis.

American Chestnut Blight. The American chestnut, once the premier hardwood forest tree of the Eastern United States, tenaciously clings to existence as a result of chestnut blight. Use of new biotechnology tools has permitted manipulation of the dsRNA to change lethal fungus strains to benign ones. This has the potential to help preserve the American chestnut.

Surge Flow Surface Irrigation. An interdisciplinary regional project on surge irrigation water applied in a series of short pulses to the field surface has led to water savings, under some conditions, as high as 4-5 inches per year with substantial cost savings when water is pumped. A future effort will be directed toward the development of automated equipment and related control facilities.

Embryo Transfer Technology. California State Agricultural Experiment Station scientists have developed a procedure that uses an antibody to a male-specific factor to identify the sex of embryos after they are flushed from the donor female and before transfer to recipients. Thus, a decision can be made prior to transfer whether the expense of the transfer and maintenance of the recipient female should be incurred.

Aseptic Processing and Packaging of Foods. Food scientists at Purdue University, working in concert with industry, have been among the leaders in developing aseptic bulk storage processing

as well as in determining product sterility, shelf life and methods for packaging and transporting aseptically processed food products. This process saves energy and improves flavor.

McIntire-Stennis Research

Forest Crop Improvement. Tissue culture methods for producing select tree clones in test tubes, laboratory gene manipulation, and greater fundamental knowledge of plant regeneration and cell differentiation offer the tree breeder the opportunity to circumvent the time-consuming sexual reproduction of trees--a key step in tailoring forest planting stock to suit different sites and markets. Recent progress will help meet some of the needs, for example, in the Southeast where 1.4 billion trees are required for planting each year.

Protection of the Forest. Forest scientists at the University of Wisconsin-Madison have indicated the significance of stomata in the white pine needle on infection and expression of hereditary resistance. These results have increased our understanding of the mechanisms of resistance to the most serious disease of white pines--blister rust. Such efforts are now being coupled with breeding efforts designed to develop blister-rust resistant trees.

Evans-Allen Research

Maximizing Catfish Production in Farm Ponds. Fisheries biologists at the University of Arkansas-Pine Bluff have developed and refined fish production techniques to increase channel catfish yields from farm ponds. By using a combination of cage culture, periodic harvesting, and fish removal from open-pond areas, annual production per-unit area may approach that of commercial fish production ponds. Thousands of existing farm ponds are available for such culture using this refined technology.

Special Research Grants

New Test Developed To Detect Bluetongue Virus Infection in Sheep. Using recombinant DNA technology, University of Alabama scientists have developed a diagnostic test for detecting bluetongue virus infections in sheep. The test can easily identify sheep harboring the known serotypes of the virus. Bluetongue may cause mortalities ranging from 5 to 30 percent. The new test should be particularly valuable in rapid diagnosis of the disease and in assuring that animals for export are free of the disease.

Forest and Agricultural Residues, A Promising Power Plant Fuel. This pioneering study at Oregon State University has shown such a power plant to be economically competitive with larger central power stations and that underutilized forest slash and other agricultural residues are viable environmentally

acceptable fuels. Thermal efficiencies, mechanical reliability, resource availability, air emissions, engineering constructability, financial and economic viability, and safety requirements were examined.

Crop and Forest Sensitivity to Acid Precipitation. California research indicates that lettuce is most sensitive to acidic fog and acidified rainfall. Soybean cultivars tested under laboratory and field conditions in Illinois, North Carolina, and Tennessee show no clear-cut yield sensitivity to increasing acid conditions, but differences in reaction appeared to relate to genetic parentage. Forest tree studies in New Hampshire, New York, and North Carolina show that adverse effects are more complex than expected, with ozone, drought, and disease each playing a role.

Animal Health and Disease Research

New Tests for Rapid Diagnosis of Livestock and Poultry Diseases. Research in 18 States, including extensive work at the University of California, has centered on the development of new diagnostic procedures for animal diseases which are reliable, fast, and relatively inexpensive. These tests--called enzyme-linked immuno assays (ELISA)--are being used for the rapid detection of viral, bacterial, and parasitic agents such as infectious bovine rhinotracheitis, bovine viral diarrhea, infectious bronchitis (chickens), and cysticercosis. The general availability of these procedures has made it possible to detect the causative agents of disease much more rapidly and more simply, resulting in more efficient treatment of the diseases.

Prevention of Lead Poisoning. Texas A&M University scientists have found that thiamin (vitamin B_1) has a marked effect on the absorption and body distribution of lead. This information holds great impact for a large segment of the world's human and animal populations where diets are largely deficient in this vitamin and where exposure to lead is not uncommon. The results indicate that large doses of thiamin are effective in helping to retard the absorption of lead and also appear to be beneficial in the treatment of animals exposed to this toxic metal.

Competitive Research Grants

- Enzymes controlling starch production have been obtained from isolated, intact amyloplasts of developing maize endosperm.

- Mechanisms of virulence and avirulence in pathogenic organisms can now be probed as a result of DNA biotechnology using both plasmids and transposable elements.

- The molecular basis for the variability in the size of the mitochrondrial genome has been described. Several of the

genes encoding for various enzymes in maize have been isolated.

- Stable isotopes of trace metals such as manganese have been used to indicate requirements and possible nutrient deficiency disorders in humans.

- Ultrafast electronic processes in light absorption by chlorophyll pigments can now be analyzed within the picosecond-time range with the aid of new instrumentation.

- The exudate of root-knot nematodes, which stimulate the host plant to produce giant cells on which the nematode feeds, has been isolated and characterized.

- Mutant strains of nitrogen-fixing bacteria which can counteract a wasteful side reaction have been isolated. These strains conserve and reutilize energy in the form of hydrogen that is lost by normal strains.

The modification of plasmid DNA carried by a plant-infecting bacterium has been achieved with biotechnology techniques. It will be possible to use the bacterium to produce desirable changes in higher plants by transformation of their DNA.

New Approach in Nutrition Monitoring	As part of the National Nutrition Monitoring System, HNIS plans, oversees, and analyzes information from the Nationwide Food Consumption Surveys and methodology studies for these surveys. A new type monitoring mechanism--a Continuing Survey of Food Intakes by Individuals--was designed to help meet dietary data needs of the government and others in a more timely manner. This continuing survey will be initiated in spring 1985. Also, a study of food consumption and costs in households in Puerto Rico was planned and conducted to help access the Nutrition Assistance Program, which replaced the Food Stamp Program there.
Joint Nutrition Monitoring Committee Convened	A committee of outside experts, supported by staff of HNIS and the National Center for Health Statistics of the Department of Health and Human Services (DHHS), is preparing a report to Congress on the nutrition of the population utilizing data from all segments of the National Nutrition Monitoring System.
Nutrient Data Bank Modernized	HNIS modernized its Nutrient Data Bank system to help provide more efficiently, accurate, and up-to-date information on the nutrient composition of all foods important in American diets. Comprehensive reference tables on the nutrient composition of vegetables and of nuts and seeds were published. The content of about 25 nutrients in the thousands of foods Americans eat were determined and entered into a data file for use in appraising diets reported in the Continuing Survey of Food Intakes by Individuals.
Food Supply Appraised	The nutrient content of the 1983 per capita food supply was estimated and added to the series showing comparable statistics annually since 1909.
Thrifty Food Plan Used for Food Stamp Benefits	The thrifty food plan was adopted as the basis for benefits provided to households in the Food Stamp Program. This food plan is the least expensive of four nutritious food plans for which costs are estimated monthly.
Committee Assesses Dietary Guidelines	A group of nine outside nutrition scientists reviewed the Dietary Guidelines for Americans published jointly by USDA and DHHS in 1980. This Advisory Committee will make recommendations to the two Departments early in 1985 about the possible need to revise the guidelines. HNIS provides staff support of this Committee.
Red Cross Nutrition Course Published	A four-year cooperative effort with the American National Red Cross provided a 12-hour nutrition course now being offered in 3,000 local Red Cross Chapters. The course contains a food guidance system that helps participants follow the dietary guidelines.

Bulletins for Consumers and Leaders

Three bulletins were published for consumers and leaders: "Your Money's Worth in Foods" helps the consumer to plan and shop for nutritious and satisfying diets. "Meat, Poultry, Fish, and Eggs: Selection, Storage, and Preparation" presents guides and procedures for handling these foods in the home. "Recipes for Quantity Food Service" is a file of standardized recipes for inexperienced food managers who plan and serve food to large groups.

U.S. Agriculture's Link to the General U.S. Economy	ERS researchers assessed the responsiveness and capacity of U.S. agriculture in a study focused on the forces most likely to affect the demand for and supply of U.S. agricultural products, including trade and natural resources, over the coming decades. Although long-term prospects for growth in U.S. grain exports suggest mostly acceptable trends for U.S. agriculture, the world food balance is likely to oscillate between years of excess production and relative scarcity.
Structure and Performance	Changes in the way hogs are produced affect the input and supply industries, marketing, processing, and distribution firms, and the issues with which public policymakers must deal. An ERS study of the U.S. hog industry shows that large operations had clear and substantial advantages over smaller operations, indicating that the shift to large operations will probably continue. Continuing structural changes in commodity markets were also assessed. An economic model used to explain trends in sorghum demand and prices suggests that U.S. sorghum demand is not very responsive to changes in price.
Policies and Programs	ERS research focused on the issues and topics likely to be raised in preparing the 1985 farm bill. A series of background papers summarizing the experience with various farm programs and the key characteristics of the commodities and the farm industries that produce them were published.
Food Prices, Consumption, and Expenditures	Food demand is related to a variety of economic and demographic factors. Decreasing population growth, an older population, and more women in the labor force, for example, have contributed to shifts to more processed products, which has implications for the types of foods produced, the processing and distribution sectors, and food prices.
International Trade	A primary focus of ERS research is the effects of foreign policies on U.S. agriculture. The recently increased importance to U.S. agriculture of trade, price varibility, and linkages to the rest of the economy has faced U.S. agriculture before but not since the 1920's.
Foreign Production, Consumption, and Prices	Many foreign countries have become self-sufficient in food production and shifted trade patterns to their advantage. Acreage harvested in the United States for major crops increased by 21 percent between 1979-81, with a very large share of the additional production being sold abroad. Foreign countries also greatly increased their exports, however, resulting in the U.S. share of world agricultural exports increasing only moderately, from 14 to 18 percent of the world market over this period.

Foreign Debt and Financial Stress

ERS research illuminated the severity of debt and financial stress in many developing countries and their effects on trade and economic growth. Many of the current debt problems of the developing countries began after the 1973-74 oil crisis and intensified with the shift to tight monetary policies by the developed countries in the late 1970's. The debt problems of developing and centrally planned countries will limit their ability to purchase goods in the world market for several years. Resolution of those debt problems would increase total trade and could possibly increase U.S. agricultural exports by as much as 20 percent.

Food Aid Needs

Many countries do not participate in the world's commercial markets because of limited production and financial capabilities. Most are critically short of arable cropland, maintain very low food reserves, and receive a large share of their consumption as food aid. Food imports needed to maintain current per capita consumption level in 67 food aid recipient countries increased by 1 million metric tons in 1984/85 to a total of 30.8 million tons. An ERS study of 11 sub-Saharan African countries found that poor agricultural performance, coupled with frequent droughts and severe foreign exchange constraints, caused per capita consumption to decline despite larger cereal imports and larger shipments of food aid.

Natural Resource Conservation and Erosion

ERS developed a new system for classifying soils with respect to physical and economic erosion hazards. The new classification indicates that 37 percent of U.S. cropland is inherently nonerodible under all management regimes, and 55 percent requires conservation management to keep soil losses within tolerable limits. The remainder is so erodible that soil losses will be excessive under intensive cultivation regardless of conservation programs. Those distinctions suggest that Federal conservation programs should be targeted to land whose erosion problems can be controlled.

Cooperative work with the Agricultural Research Service found that erosion and off-farm pollution can be reduced without significantly affecting farm incomes when farmers adopt conservation tillage, change crop rotations, and improve fertilizer management.

An ERS study of drip irrigation on cotton in Arizona indicates that drip irrigation reduces water application requirements 30 to 50 percent, making it potentially more profitable than conventional furrow irrigation. Drip irrigation results in no significant decrease in yields, and in some tests has sharply increased yields.

An ERS study concluded that if the virulent disease, soybean rust, became established, aggregate incomes for soybean farmers would be higher as a result of higher soybean prices. Incomes for dairy and livestock producers would be lower because of higher feed prices. Prices for processed foods, meat, and dairy products would also increase.

Effects of Public Programs on Resource Use

An ERS assessment of the 1983 acreage reduction and PIK programs indicated that soil erosion was reduced by 25 percent on the diverted acres. While significant soil, water, and wildlife conservation benefits were achieved, the benefits could have been greater if more cover were required on the diverted acres and if more of the highly erodible lands had been included in the program.

An ERS study of natural gas deregulation evaluated three options: deregulation between 1983 and 1990, a 2-year freeze, and accelerated decontrol. Only small differences were noted in crop and livestock production, variable production costs, prices received by farmers, and net farm income among the deregulation strategies.

An ERS study in Washington State suggests that targeting, the concept of concentrating conservation efforts in geographic areas or on problems considered most critical, was effective in accelerating the adoption of conservation measures in critical eroding areas. Farmers participating in the soil conservation targeting program generally had larger farms and more education than the average farmer.

Economic Development of Rural America

ERS demographers kept a close eye on the relative rates of population growth between metropolitan and nonmetropolitan areas to determine whether the rural population turnaround of the 1970's continued into the 1980's. The nonmetro growth rate appears to have declined to about the same as the metro rate, which has remained stable.

The last two farm population surveys both showed about 5.75 million living on U.S. farms. However, ERS research shows that an increasing proportion of people living on farms are employed in nonfarm occupations.

ERS analysis indicates that most of the inadequate housing in the United States has been eliminated during the last 50 years, but important pockets remain in some rural areas, especially in the South and among rural blacks.

ERS has provided Federal policymakers with new data on the overall condition of the stock of public capital in rural areas. Initial analysis of data from the National Rural Community Facilities Assessment Survey (NRCFAS) indicates that, for most facilities examined, the absence of public infrastructure was most pronounced in unincorporated areas and in the smallest towns.

Objective Yield Measurement Research and Analysis

Objective yield measurement procedures for rice, grain, sorghum and sunflowers, developed during 1980-83, were made operational in 1984. A cooperative study with North Dakota State University continued to research production characteristics affecting sunflower survey methodology. Overall program emphasis moved to the assessment of data quality and model accuracy.

Plant Growth Simulation Modeling

Research continued on plant growth process simulation models as candidates for supplementing or replacing the present yield forecasting system. Growth simulation models are structured with functional relationships representing growth of the plant using inputs for the modeled simulation of growth which the plant itself uses. SRS is cooperating with ARS in the development of models for corn, wheat, and soybeans by working directly with their modelers in validating model capability for potential use in SRS operating programs. Through cooperative agreements with university scientists, additional or supplemental model development research is underway for soybeans, cotton, and grain-sorghum models. Models thus far tested contain structural or parameter estimation problems that make them unfit for Agency use. However, some ongoing efforts in soybeans and cotton show promise--techniques have been developed to utilize survey measurements to true up model response.

In addition, two new modeling techniques have spawned from this research. The first employs a nonlinear time series approach to forecast the output of a plant-process model, while the second uses a finite discrete Markov process model to depict yields. Both of these techniques are promising. Seven research papers covering the process-model analysis and the new forecasting techniques are under preparation.

Computer Assisted Telephone Interviewing (CATI)

The California State Statistical Office (SSO) used CATI succesfully to collect data for six major surveys this past year. Development of new applications and new system enhancements were also evaluated. This included updating files for the Agency list sampling frame and direct data entry for other non-CATI surveys. The Nebraska SSO used a split-sample survey to compare quality of CATI with non-CATI telephone data. Analysis indicted a reduction in critical errors is obtained when CATI is used.

Another major development in the project was the adoption of a plan to increase the number of States with CATI capabilities. This action moved the project from a purely research environment into a more operational setting.

Area Frame Construction

A study was initiated to compare operational stratification procedures for area sampling frame construction, which are based

on photo interpretation, with a method using computer classification of digital Landsat data. The test area includes three counties in Florida and four counties in Wyoming. Computer classification has the potential to eliminate the subjectivity of visual interpretation and allow the use of data from different time periods to improve separation of cropland and pasture. It will also eliminate the need for specific knowledge of crops grown in an area.

Small-Area Estimation

Research continued on the development of a model-based procedure which used historical and current data to make district and county estimates. Early results showed the estimates from this procedure were more stable and closer to Crop Reporting Board values than estimates based only on current data. Analysis has been completed using one year of historical data for modeling. Two additional years of historical data are now being evaluated. A formal report is being prepared.

Research To Develop Methodology for Using Satellite Data

In 1984, Landsat multispectral scanner data were used with SRS ground-gathered data to calculate improved crop estimates at the State and county level in seven Midwestern States. Data were obtained from both Landsat 4 and 5 which resulted in much better coverage in the major producing agricultural areas. Delivery of data from NOAA was generally good.

Estimates for planted and harvested acreage of winter wheat were obtained in Colorado, Kansas, Missouri, and Oklahoma. Processing is underway to generate 1984 acreage estimates of rice, corn, and soybeans in Missouri; rice, cotton, and soybeans in Arkansas; and corn and soybeans in Illinois and Iowa. In addition to the crop acreage estimates, a cooperative project between the Statistical Reporting Service, Soil Conservation Service, and Forest Service was conducted in Arkansas to obtain estimates of major land covers including forests and nonagricultural uses.

In 1984, research continued in the use of satellite data to improve area estimates for various specialty crops. Much of this work was done in cooperation with other organizations. Projects were carried out in Idaho for potatoes, New York for orchard, vineyard, and vegetable crops, and California for numerous specialty crops.

Research on statistical methodology, use of data from the Thematic Mapper sensor, data processing (including both hardware and software), automation, and other techniques to increase efficiencies continued in 1984. Major developments included batch data processing capabilities, and continued refinements of a video scanning procedure for recording field locations from aerial photographs.

1983 Ag Co-op Net Margins Rose 25 Percent

Combined business volume of 5,989 agricultural marketing, purchasing, and service co-ops for 1983 was $66.8 billion. Though sales declined 3.6 percent, net margins rose 25 percent to $1.1 billion. Total assets were $28.8 billion and member and patron equity $11.5 billion. Co-op memberships were 4.95 million, indicating many farmers belong to more than one co-op.

Top Co-ops' Sales Dipped; Margins More Than Tripled

Sales of the 100 largest co-ops were $48.8 billion, down 8.9 percent from $53.6 billion. Net margins tripled, from $127 million to $397 million. Assets totaled $16.9 billion, a decrease of 1.1 percent. Net worth increased slightly to $5.3 billion. The proportion of equity capital used to finance assets increased from 30 to 31.6 percent.

Three Decades of Growth Tracked

Between 1951 and 1981, the number of co-ops dropped from 10,000 to 6,200 but combined sales increased from $10 billion to $71 billion. The co-op share of marketing farmers' products increased from 20 to 30 percent. Co-op marketing grew at a 19-percent annual rate, compared with an annual growth rate of 11 percent for total farm marketing. Co-ops' share of providing farmers' production supplies rose from 12 to 20 percent. Co-ops' share of purchasing activity grew at an annual rate of 26 percent, compared with a 15-percent annual growth rate for total farm production expenditures.

Grain Marketing Assessed

Farm-level purchases of grain by local co-ops account for about 40 percent of U.S. farm grain sales, while regional and interregional grain co-ops assemble 40 percent of U.S. grain exported. Co-op grain-handling operations represent 28 percent of U.S. elevator facilities and 38 percent of total U.S. elevator storage capacity.

Work Continued Toward Boosting Export Sales

Research and promotion continued toward helping co-ops improve and strengthen their capabilities in international trade. Marketing opportunities were assessed for grain and oilseeds with Czechoslovakia, the German Democratic Republic, Hungary, and Poland. U.S. exports to these countries totaled $497 million in 1982, representing 2.4 percent of total U.S. agricultural exports. A buyer's guide to dealing direct with grain co-ops was updated and guides on pulses and fruits, vegetables, and nuts were developed.

Dairy Marketing Operations Evaluated

Data for 435 dairy co-ops show they marketed 95.6 billion pounds of milk, or about 77 percent of all milk sold to plants and dealers in 1980. There were 146 co-ops with no milk handling facilities, 97 with only milk and cream receiving stations, and 192 operating 456 dairy processing and manufacturing plants. Cooperatives sold about 16 percent of the Nation's packaged fluid products, 10 percent of the ice cream, 64 percent of the

butter, 87 percent of the dry milk products, 22 percent of the cottage cheese, and 47 percent of all other cheese made in the United States.

Wool Marketing Update Looked at Co-op Role

For the first time in more than two decades, an industry update was developed for co-op wool pools and warehouses. Data for 1981 showed 158 wool marketing pools and 9 warehouses. Pools operate a few days each year to assemble and sell wool. Warehouses operate daily and also grade, store, and blend wool to buyer specifications. Pools frequently sell without knowledge of grade and clean fiber content. Processing, consolidating pool and warehouse marketing, and pricing to reflect clean fiber content are options to lower marketing costs and strengthen producer market power.

Fruit, Vegetable Working Approaches Evaluated

Organization and operations of nine working arrangements developed by fruit and vegetable processing co-ops were evaluated for benefits. Three distinct approaches were identified: contractual agreement, affiliation through membership status, and formation of a separate business entity. The specific structure and functions of joint undertakings reflect the needs and preferences of the participants. Benefits perceived in these approaches included scale economies in processing and marketing, capital cost avoidance, product diversification, assured commodity supply, and enhanced market entry.

Technical Help Given to 67 Producer Groups

Sixty-seven technical assistance projects involved 94 co-ops and producer groups, of which 47 projects were for emerging or developing co-ops. Commodities included grain, soybeans, cotton and cottonseed, strawberries, peanuts, fruits, vegetables, beef, dairy, handcrafts, feed, and other farm supplies. Examples were an examination of the impact of reorganization of the co-op ginning industry in West Texas; an assessment of the market for ice cream products in Japan; assistance to five fresh vegetable marketing co-ops in forming a federation to lower management service costs; and determining the feasibility of converting an Hawaiian beef slaughter company and beef processing-marketing company to a producer-owned co-op.

Educational Materials Catalog Updated

A catalog of more than 100 titles of publications available for educational programs was updated. New publications were issued on historical statistics and poultry and egg co-ops, and how co-ops can benefit outdoor recreation ventures. Major revisions and updates were completed on the tax treatment of co-ops and co-op facts. Fifty short-term, high-response projects involved providing exhibit and publications materials, staff participation in seminars, and in planning programs.

Develop A Marketing System	The methodology that was developed to help farmers identify market opportunities has been extended to establishing a marketing system that has successfully worked. Farmers in southside Virginia successfully marketed more than $300,000 worth of fresh broccoli and cantaloups last year, which was only their second year in vegetable production. The first year they realized a net return to their labor of an average of $861 per acre with sales of fall broccoli to retail food chains. They are planning to build a facility for their cooperative to pack, inspect, grade, and cool their vegetable production beginning with the next fall crop of broccoli. Requests to see if the marketing approach developed by AMS in Virginia will work elsewhere have come from Oklahoma, New York, Iowa, and several other States.
Wholesale Market Facilities	Studies have been completed for new wholesale food distribution centers for southern New Jersey and Raleigh, North Carolina. With surveys of 230 firms, data collection has been completed and analyses begun for determining the need for improved wholesale distribution facilities for San Diego, California.
Software for Produce Wholesalers	After detailed analyses of the operations of produce wholesalers, and working with a software contractor, AMS developed an integrated software package to help with operations and inventory control that is more sophisticated than others that are currently available and are not easily tailored to produce wholesalers. At half the cost of the commercial packages, the system has been successfully tested by a produce wholesaler who is ready to adopt it.
Container Standards	Considerable progress was made in reducing the number of case sizes used in handling produce, frozen food, and dry groceries, to reduce costs and improve efficiency. Six additional container sizes were added to the approved container list for produce under Project MUM. President Reagan recognized the private sector contributions to this initiative. Recommended replacements for containers now being used for frozen vegetables would result in a 79-percent reduction in container sizes (125 to 26), and for frozen meat, poultry, and seafood an 81 percent reduction (212 to 41), if adopted. A study identifying barriers, opportunities, and research needs to reduce the number of case sizes in grocery distribution was recently completed under a cooperative agreement with Michigan State University.

Michigan Beans	Research to improve the handling and exporting of cranberry beans has been credited with establishing a $12 million annual market in Italy. A test of a van container liner for bulk shipment of beans to England was successfully completed. The liner has the potential of lowering shipping costs by replacing the bags currently in use.
Credit Rating Model Developed	A credit rating model was developed for all the licensed grain warehouses in the Nation. To date, the financial statements of 2,550 warehouses have been evaluated under the risk rating system.

Deregulation Meetings

The Office of Transportation conducted several informational meetings in Southeastern United States to help grain shippers and receivers better understand the provisions of the Staggers Rail Act. Workshop panelists from industry, government, and academia addressed such topics as contract negotiations, market dominance, and major impacts of the 1980 law on agricultural marketing.

Deregulation Assessment

OT has continued to monitor the impact of the Staggers Rail Act on American agriculture. The planned process consisted of nine regional meetings, numerous visits to shippers, and both written and oral comments received from grain producers and other industry representatives. An assessment report "Effects of the Staggers Rail Act on Grain Marketing," published by OT in July 1984, identified key post-Staggers issues affecting grain shippers. They were lack of information on rail contracts, concern about actions of carriers in rail-dominated markets, and unilateral cancellation of joint rates through routes and reciprocal switching agreements. Several recommendations cited in the report called for the ICC to establish specific procedures to determine undue discrimination, reevaluate rate reasonableness criteria, and review the entire matter of unilateral cancellation of rates and routes.

Rural Road & Bridge Issues

OT initiated a survey of the rural road and bridge situation and financing methods in Illinois, Wisconsin, Minnesota, and Ohio to develop a process by which local officials could quantitatively compare their roadway needs and revenues, identify potential management practices for improving the efficiency of the local government operation, and communicate more effectively their problems and accomplishments to the public.

Also, a followup to last year's pilot study in Pennsylvania resulted in a complete county-by-county identification of essential agricultural access roads, key bridges, and the obstructions on this network. OT was the principal facilitator that led to the involvement of Federal, State, and local government representatives and agricultural leadership in each county. A 30-minute video tape and a publication describing the latter program are available to interested persons.

Cattle Shipment By Container On Flatcar

A new 40-foot container, equipped to hold up to a 12-day supply of feed and water and developed by the MASSCO Corporation, for shipping cattle by rail or vessel was tested by Texas A&M University and OT researchers. Two of the double-decked containers were placed on a rail flatcar and loaded with 100 feeder calves in Winter Haven, Florida, and shipped to Amarillo, Texas. During the 48-hour shipment, OT personnel monitored the

	animals via closed circuit TV and recorded measurements of the in-transit environmental conditions.
Truck Refrigeration Improvment Research	A cooperative research project conducted by the Agricultural Research Service, the University of California, and private trucking companies and OT studied the air distribution system inside refrigerated trailers. Test shipments of fresh fruits and vegetables were conducted in which the in-transit environment was closely monitored to determine refrigeration performance. Consistently uniform pulp temperatures of agricultural products shipped in the experimental trailers during transit indicates better environmental control is possible. This should result in a longer shelf life for the product.
Cryogenic Railcar International Award Nomination	A cryogenically refrigerated railcar was one of 10 refrigeration developments nominated for the "Innovation of the Year" Award at the International Frozen Food Congress and Exhibition in Copenhagen, Denmark. OT was a major cooperator with the American Frozen Food Institute and the International Association of Refrigerated Warehouses in the research and development of the cryogenic railcar. The railcar uses liquid CO_2, a petroleum byproduct, to refrigerate loads of frozen foods and offers an alternative to diesel/mechanical refrigeration for transport vehicles.
Physical Distribution Productivity Measurement Program	"Productivity Measurements of Regional Farm Supply Cooperatives" provides an indepth analysis of operating policies and physical characteristics of selected farm supply cooperatives. The study, a joint effort conducted with the National Council of Farmer Cooperatives, provides distribution managers with information to develop improved productivity measurements. Uniform application of these measurements should provide the basis for increases in cost control and efficiency.
Middle East Ports Survey	OT has participated in a number of international transportation development programs designed to foster increased agricultural exports. A survey of 15 Middle East port facilities was conducted to determine handling capabilities and infrastructures to accommodate agricultural imports such as grain, canned goods, fertilizer, cement, fresh and frozen fruits and vegetables.
Export Trading Companies	This OT study determined (1) the role of transportation entities in an export trading company (ETC), (2) the pros and cons of integrating transportation into a joint venture, and (3) profiles of probable ETC structures. The results, which included a survey of exporting firms, were presented before the 25th Annual Meeting of the Transportation Research Forum.

United States--Mexico Cooperation	OT has initiated negotiations between the United States and Mexico in the coordination of U.S. grain exports. Various trade issues at rail border crossing points were resolved between the two countries. Meetings, hosted by OT, were attended by grain exporters, railroad representatives, brokers, and Conasupo representatives to discuss mutual problems.
Landing Rights	Technical assistance was provided, in conjunction with the CAB and the State Department, on problems involving American-Flag charter aircraft carrying U.S-produced livestock, in requests for landing rights at various Venezuelan airports.
Caribbean Basin Initiative	OT participated in a discussion on transportation of agricultural products as part of the Annual Miami Conference on the Caribbean. OT discussed its role in providing services regarding transportation of perishable commodities by ocean and air.
Central American Seminars	OT joined a team of U.S. agricultural industry representatives to conduct seminars in Guatemala, El Salvador, and Honduras to acquaint local importers of U.S. agricultural products with the cash and futures marketing practices of the United States. Information was presented to Latin American importers on ocean livestock transportation and improved methods for importing bulk commodities.
Food Relief	The Agency for International Development (AID) has requested OT assistance in providing a tracking system for food shipments from the United States to African countries. The efforts seeks to coordinate food delivery to combat famine in Ethiopia and Sudan.

Scientific and Technical Exchanges	Scientific and technical exchange activities are designed to support the interests of U.S. agriculture and agribusiness. Activities range from exploratory research to direct requests for technology transfer. These exchanges seek to gain new knowledge, facilitate the entry of the private sector and institutions into bilateral activities, address strategic commodity and environmental concerns, utilize science and technology more aggresively in market promotion, and collect statistical information. During FY 1984, a total of 98 exchanges involving 243 U.S. and foreign scientists were carried out in 24 countries under bilateral agreements. Exchange expenditures during the fiscal year totaled more than $450,000.
China Citrus Symposium	The United States hosted a citrus symposium where information was shared among U.S. and Chinese citrus scientists on the status of citrus research in both countries. Germplasm for future exchange was identified and a mechanism established for exchanges. China will host a reciprocal symposium on citrus research at a later date.
Zimbabwe Veronice Germplasm Collection	Veronice is a plant which produces high-grade, industrial-type oils as well as being a good fodder source. It grows well in semiarid zones. Presently its use is limited by the small oil output per plant. Two USDA scientists visited Zimbabwe and neighboring African countries several times during FY 1984 searching for different varieties of Veronice; a variety may be found that will produce substantial quantities of oil.
Australia Cotton Bollworm Sterility Mechanism	The Heliothis pest species affects production of cotton, soybean, tobacco, corn, and many other crops around the world and causes hundreds of millions of dollars of losses in the United States alone. Heliothis is the major obstacle to successful cotton production in most U.S. cotton-growing areas, and the estimated cost of insecticides to control it exceeds $50 million per year. Because the species has developed resistance to insecticides, and environmental concerns require us to search for alternatives to insecticides, scientists are working to develop a hybrid sterility mechanism to control Heliothis. Using specimens collected in an exchange program with Australia, researchers at Mississippi State University, the Jamie Whitten Delta States Research Center, Stoneville, Mississippi, and elsewhere are conducting cross-breeding trials with the aim of discovering a sterile male trait.
Australia Toxicity in Livestock	Plants containing pyrrolizidine alkaloids (PA) occur throughout the United States and Australia causing death or chronic debilitation of many classes of animals and producing a cirrhosislike condition of the liver in humans. In recent years, the human food chain (milk and honey) in the United

States has become contaminated with PA. There is also concern about possible contamination of meat in slaughter cattle that have consumed plants containing these alkaloids. Further attention has been focused on the PA problem following the deaths of people in Southwestern United States who consumed medicinal teas made from plants containing PA. U.S. and Australian scientists exchanged scientific information on toxicity and metabolism of PAs and will conduct joint research studies in the prevention of PA toxicosis in large animals.

New Zealand
Irrigation Systems
Analysis

Scientists implemented a computerized simulation model for analyzing planned irrigation systems. Because the life of most irrigation systems is long, ranging from approximately 15 to 50 years, and many changes can occur affecting the operation and success of an irrigation system, it is essential that planners design the best system. The techniques developed play a key role in quantitatively identifying tradeoffs between capital and operating costs, water and energy resources, and production. Through proper system planning and design, a potential savings of 5 to 10 percent could be realized for much of the surface and sprinkler irrigated lands in the United States.

Brazil
Citrus Blight

An active research program underway in Brazil on citrus blight and blightlike declines has been developed to minimize or reduce tree loss and may be directly applicable to Florida blight. A reduction in tree loss in Florida would make Florida citrus more competitive in export trade. Prevention rather than cure is the most likely method suitable to control blight.

Mexico
Cereal Rust
Disease

In FY 1984 USDA scientists visited Mexico in the U.S. ongoing effort to maintain epidemiological monitoring capability of cereal rust disease. As airborne plant pathogens are not contained by national boundaries, an outbreak of the disease in northern Mexico could affect the wheat-producing areas of the United States. It is of great importance that presently resistant U.S. wheat cultivars be protected from any sudden development of new strains of cereal rust disease.

West Germany
Acid Rain

In FY 1984 USDA/OICD initiated and supported reciprocal scientific visits with West Germany on the effect of acid rain on the forest ecosystem and agricultural crops. During the exploratory visits, scientists assessed the research capabilities and programs and the level of damage in both countries. Areas of mutual interest and benefit were identified, including symptoms and physiological effects, economic aspects, and soil-plant interactions. Policymakers and the scientific community fear that potential pressure to reduce emissions (particularly sulfur dioxide) is developing faster

than knowledge about the effects on forests. The costs of additional control of sulphur dioxide is estimated at $8-10 billion annually. It is important that information from this research be available in a timely manner, because there is a good possibility that damage is caused not only by sulphur dioxide, but by a combination of several pollutants. Therefore, reduction of sulphur dioxide emissions only may not resolve the problem. Cooperation with West Germany, a world leader in this research area, will help to reduce research time.

West Germany Avian Influenza

Immediately after the outbreak of avian influenza in several States in the United States, OICD initiated an exchange with West Germany related to this disease. The scientists will jointly work on basic research concerning diagnosis and on determining the virulence potential of avian influenza. West Germany has made substantial progress in the area of molecular virology of the avian influenza viruses. Joint work in this area is of high priority in view of the recent outbreak which cost about $61 million in lost poultry and control expenses, including quarantine and onsite inspections. If the scientists could determine the potential virulence of avian influenza viruses, similar outbreaks and subsequent economic loss could be prevented.

France Douglas Fir Genetics Research

Joint work is supported with France on controlling and manipulating the flowering process and seed production of Douglas fir. It is anticipated that this joint work will affect the acceleration of the breeding cycle of that tree and the increase of the availability of seed from selected clones of Douglas fir (and eventually other species, if the techniques are successful). This will improve forest reforestation efforts and the productivity of timber production mostly in Oregon and other Northwestern States. It is estimated that in Oregon alone the improvement of reforestation efforts by 10 percent through this research would increase productivity at the value of $24 million per year.

Research Grants

Under Sections 104 (b)(1) and (3)(b) of P.L. 480, OICD made 30 research grants overseas during the fiscal year totaling over $3.6 million equivalent in local currency. Collaborative research agreements totaling $470,000 were made with U.S. research institutions for joint projects with institutions abroad. Projects covered research in plant science, entomology, veterinary science, soil and water, agricultural economics, and forestry.

Weed Control

The control of many species of noxious weeds is being studied at 13 locations in India. In addition to identifying and describing the biology of these weeds, the researchers are

pinpointing weak links in their life cycles and developing control techniques that efficiently attack these weak links. The techniques being used are (1) induction of early germination before environmental conditions will allow survival, (2) screening of various herbicides and herbicide mixtures, and (3) competition among weeds and crops for essential nutrients. Soil samples also are being analyzed to determine the extent of herbicide residues. This information is directly applicable to weed-control problems in the United States.

Livestock Disease

Yugoslavian scientists have developed a valid test for listeriosis, a livestock disease known to infect humans. When present in animals, listeriosis causes infected livestock to circle around and around in a daze. Listeriosis has human symptoms very similar to those of mononucleosis. It is a suspected factor in miscarriages. A recent outbreak in the Boston area resulted in several human deaths and has reemphasized the importance of this research. As a result of this project, veterinarians will be able to test suspected herds and contain the disease. This should help prevent its spread to other animals and humans.

Bee Parasites

Honeybees are essential for the pollination of many major U.S. crops. These bees are very susceptible to fatal infestations by various species of mites not now present in the United States. Should these mites arrive in North America, the effects could be devastating. To prepare for this possible invasion, studies have begun in Yugoslavia and Brazil on the abilities of bees to resist mite infestations. Researchers will determine what genetic variation in resistance exists among infested bees. Positive evidence of resistance will guide breeding efforts. Environmental factors will also be assessed for their effects on these parasitic mites.

Rice Disease

Indian scientists screened 200 varieties of rice to determine susceptibility to tungro virus, ragged rice stunt, bacterial blight, and rice blast diseases and identify resistant strains. The rice types developed by the 5-year program will provide sources of resistance which can greatly benefit our cooperative Federal-State rice improvement program.

Tomato Diseases

Scientists at the Research Institute of Vegetable Crops in Skierniewice, Poland, have developed a new screening method to find resistance to Phytophthora parasitica in tomato varieties. The entire U.S. germplasm collection of tomatoes could be tested to identify resistant lines, at essentially no cost to the U.S. Government. Currently this fungus is being controlled in the United States by chemical fungicides at a cost of several million dollars per year. Resistant genes incorporated into

commercial varieties would save this cost and reduce chemical pollution.

Karnal Bunt

Karnal Bunt, a serious disease of wheat, was discovered in U.S.-operated wheat seed development nurseries in Mexico in early 1983. This disease originated in South Asia. India and Pakistan are ideal locations for research. Scientists and research sites have been identified, research plans prepared, and work has begun to determine the most effective ways of combatting this disease. The ability to do this type of research in the country of origin is very important because of the danger of contamination if done in the United States.

Livestock Disease

Research in Yugoslavia has confirmed the viral cause of Sheep Pulmonary Adenomatosis (SPA) and its transmissible nature. The information facilitates U.S. research in developing serological tests for early diagnosis and a vaccine for control of the disease.

New Crops

Studies in India, on previously uninvestigated seed oils, revealed the presence of usable quantities of common fatty acids such as palmitic, oleic, and linoleic. Since new crop sources are needed, those discoveries are beneficial to U.S. agriculture. Likewise, discovery of new seed oils rich in epoxy acids has potential for giving U.S. agriculture a new crop that is profitable and energy-conserving. The Vernonia species examined in this program provide additional germplasm for plant breeding work aimed at establishing a high-epoxy oilseed crop.

Embryo Transfer

Research in Yugoslavia and Pakistan will provide information on the transmissibility of livestock diseases by embryo transfer. Preliminary research has shown that certain infectious diseases are not likely to be transmitted by embryos. If this proves true, breeders can exchange bloodlines without danger of also exchanging diseases. Embryo transfer is more efficient than artifical insemination for upgrading livestock in developing countries. Not only is the transferred embryo free of diseases from its biological parents but also the surrogate mother provides acquired immunity to native diseases at birth. The results from this research will enable quarantine officials to draft new rules for international trade in livestock embryos.

Pome Fruit Rootstocks

New rootstocks for apple trees were developed in Poland during several years of research sponsored by the Special Foreign Currency (SFC) Program. In addition, several rootstocks developed in the Soviet Union have been received through Polish researchers. These rootstocks, none of which would be available to U.S. apple growers without the SFC Program, are currently advertised in the catalogs of U.S. rootstock suppliers.

Applications of Biotechnology

Researchers at the Forest Products Laboratory have discovered a lignin-degrading enzyme. The discovery of this enzyme opens the possibility for many applications of biotechnology in wood processing, biopulping, biobleaching, conversion of lignin to useful chemicals, and cleaning up noxious lignin wastes from pulp and mills.

The development of new genetic lines of trees resistant to plant diseases using traditional breeding techniques is a costly and time-consuming process. A new advancement in plant breeding, called somaclonal variation, can dramatically reduce this evaluation time. The technique involves isolating single vegetative cells in a culture from which callus tissue and plantlets are later developed. Research on resistance or tolerance to diseases and detrimental abiotic factors using the somaclonal variation technique is being coordinated closely with research of scientists who are trying to produce trees with desirable silvicultural characteristics.

Atmospheric Deposition Research

In fiscal year 1984, the FS continued its program of atmospheric deposition research in coordination with other member agencies of the National Acid Precipitation Assessment Program (NAPAP). It is possible that atmospheric deposition in the United States is causing detrimental acidification of lakes and streams, and is contributing to reduction in forest health, vigor, and growth. In the Eastern United States, unexplained forest declines and growth reductions have been observed. In Europe, severe economic and ecological damage to forests are occurring that are probably linked to air pollutants.

Recent research findings in 1984 include:

- Nitrogen oxide emissions in the Los Angeles basin were shown to be major sources of acidic deposition affecting nearby mountain watersheds.

- Clearwater lakes in the northern Lake States show evidence that acidification of some of those lakes is related to acidic precipitation.

Study of sap in several tree species has shown a reduced sap pH that may result from incorporation of increased nitrogen into amino acids. The depressed sap pH might contribute to tree stress.

CANUSA Program Completed

The Canada/United States Spruce Budworms Program (CANUSA) was completed on September 30, 1984. The objective of this program was to design and evaluate strategies for controlling spruce budworms and managing budworm-susceptible forests.

Important program accomplishments include:

- Strategies to prevent or reduce losses during outbreaks through improved forest management practices that reduce reliance on chemical controls.

- Hazard rating guidelines to identify areas of high budworm damage potential, permitting managers to take corrective actions.

- New products and markets for budworm-killed trees, and salvage guides for utilization of threatened or damaged stands. A management decision support system consisting of models and sets of alternative treatment strategies needed to deal with budworms.

- CANUSA represents a valuable model for guiding the development and execution of similar future international Research, Development and Application efforts.

Fire and Atmospheric Sciences Research

Researchers at the Northern Forest Fire Laboratory developed a computer system called BEHAVE that will predict the spread, intensity, and size of forest fires. This information is vital to fire managers who must make quick but far-reaching decisions about ordering, directing, and coordinating use of high cost resources for fighting fires. Scientists have trained fire managers in several Federal and State agencies in the use of BEHAVE.

Riverside, California, Fire Laboratory foresters and economists have completed the first part of an economic efficiency model that will be used to evaluate alternative fire management organizations. The model considers the cost of fire protection as well as the consequences of wildfires on the values of resource outputs.

Forest Insect and Disease Research

A Christmas tree pest manual has been published. It describes 70 major Christmas tree pests. These descriptions will help growers, nursery operators, horticulturists, extension agents, foresters, students, and others to quickly identify pests in the field. The manual also includes cultural, biological, and chemical controls that can help reduce or prevent costly damage.

Forest Inventory and Analysis

Inventories in Georgia, South Carolina, and North Carolina show a decline in the rate of pine growth which had reached a peak during the last decade. Pine stands on nonindustrial private forest lands were established largely by natural seeding on abandoned agricultural lands. Now, natural seeding is not providing reliable pine regeneration on these lands because of the existing hardwood understory.

A survey of wood use in U.S. manufacturing industries showed that more than 1.8 billion cubic feet of lumber and other wood products were consumed in 1977. Typical industrial uses include lumber for pallets and skids, mobile homes, and wood for jigs, models, patterns, and flasks. These periodic surveys of wood use help planners predict future timber demands.

Renewable Resources Economics Research

A comprehensive review of the concepts and methods for estimating the value of all wildland resource outputs was published to guide future resource valuation studies. The methodological review was augmented by a compilation of available empirical estimates of recreation values for use in multiple-use management decisions.

There are opportunities to improve timber productivity on 88 million acres of forest land in the South. Those opportunities are capable of earning a 4-percent return above inflation and would cost $4 billion. The increase in net growth from these investments would equal the total net growth in 1980 from the entire region.

Trees and Timber Management Research

A new, authoritative source of information for guiding forest management decisions is now available in Agriculture Handbook 445, "Silvicultural Systems for the Major Forest Types of the United States." This publication provides a concise, but comprehensive, state-of-knowledge treatise on alternative management opportunities for each of 48 major forest types in the United States.

Ten years of intensive research at the Northeastern Forest Experiment Station has been synthesized into a systematic, objective procedure for prescribing silvicultural treatment for cherry-maple, beech-birch-maple, and oak-hickory stands of the Allegheny region. The system can be automated, and a computer program called SILVAH is available to assist in developing management perscriptions.

Watershed Management and Rehabilitation Research

Research results show that micro-organisms in southern Appalachian forest soils rapidly incorporate sulfates into organic molecules. This conversion is rapid enough to handle the sulfur that is entering the ecosystem in acidic precipitation. This means that the effects of acid precipitation will probably not be seen as soon as they would be without conversion of sulfates to organic sulfur.

Landslides are a critical problem in rugged west coast mountains. A mathematical formula has been developed which identifies potential landslide sites with 81 percent accuracy.

Also, techniques have been developed for inventorying landslides. These results help managers assess risks, evaluate long-term productivity, monitor current productivity and damage, and prevent landslide occurrences.

Wildlife, Range, and Fish Habitat Research

Studies have shown that natural beaver ponds in small streams provide large volumes of nutrient-rich water for rearing young coho salmon. Phenomenal growth of young coho salmon was obtained in a 1-acre artificial beaver pond, which simulated the complex, nutrient-rich water of a natural beaver pond. This research is helping develop cost-effective coho salmon habitat improvement methods.

Research indicates that cattle are more compatible with deer in southern forest range than generally thought. Without management, many young pine plantations become impenetrable and produce little deer food. Regulated cattle grazing can benefit deer by improving accessibility to forage, slowing plant succession, and increasing production of preferred deer foods.

Forest Recreation Research

Recreation researchers developed a guide for resource managers which contains questionnaires, shows how to administer them, and demonstrates ways to obtain various kinds of information from river users. Information from such surveys is invaluable for making land management decision.

Study has shown that participants in the Youth Conservation Corps learned about conservation, environmental problems, and natural resource management. More significantly, however, enrollees benefited by learning how to work more efficiently, participate in group efforts, accept persons of another race, and gain confidence in their ability to find and hold jobs.

Forest Products and Harvesting Research

Scientists at the Forest Products Laboratory developed a simple, accurate chemical test to separate white and red oak logs. The test is valuable for identifying red oak logs in shipment because they can carry oak wilt disease which may be spread to uninfected areas. Use of this test now permits foreign buyers to import oak logs without having to subject the entire shipment to an expensive fumigation process to prevent introduction of the oak wilt disease.

A computer-based simulation model was developed that will help timber harvest planners create the optimum skyline yarding configuration for a particular site with a minimum amount of field work. Because yarding costs are a major expense in timber harvesting, intensive analysis and planning is justified to ensure cost-effective yarding.

International Forestry

The Forestry Support Program (FSP), a joint Forest Service/Agency for International Development (AID) effort was extended through 1988. FSP identifies sources of expertise for forestry development work in AID-recipient tropical nations. The program extension also provides for new international initiatives in forest enterprise development, forestry-agriculture coordination, and training/education development.

Forest Service personnel played leading roles in Food and Agriculture Organization (FAO) statutory bodies such as the North American Forestry Commission, Latin American Forestry Commission, Committee on Forestry, and the Committee on Forest Development in the Tropics. Through the International Union of Forestry Research Organizations (IUFRO) the FS helped to initiate a program to strengthen forestry research in developing countries.

Farm Financial Management	Extension financial management education programs assist producers in many States in preparing and analyzing cash flow and other financial statements, developing improved plans for organizing farm enterprises, and making effective marketing decisions. Intensive workshops, computerized financial management techniques, and other methods of intensive assistance are used with individual farmers to help them analyze their situation and make appropriate decisions. Legislatures in North Dakota, Nebraska, and Iowa funded expansion of individual assistance for these farmers. A pilot program to provide assistance on a fee basis was funded with money from Nebraska and from Extension Service-USDA.
Integrated Reproduction Management (IRM)	Fifteen States have IRM programs in dairy, beef, swine, sheep, or poultry, and other States are developing similar programs. Addressing all components of livestock systems, IRM programs work to restore profitability to livestock enterprises more effectively than traditional single-component educational programs.
Commodity Options Use in Marketing	Extension Service-USDA developed an educational package and held regional in-service training workshops for state Extension specialists in use of agricultural commodity options, which became available as a marketing tool in fall 1984. The specialists, often with Commodity Futures Trading Commission and commodity exchange personnel, conducted training sessions for producers, processors, elevator operators, and others.
Protecting Stored Grain	The Cooperative Extension Integrated Pest Management Program (IPM) educates grain-storage managers about pest-control options; the Pilot IPM project in Idaho demonstrates electronic monitoring of grain and ambient temperatures to allow cool, dry air to be used to eliminate insects, sprouting, and mold damage. The Pesticide Applicator Training (PAT) program teaches applicators to use pesticides safely and effectively. The National Agricultural Pesticide Impact Assessment Program (NAPIAP) involves preparation of comprehensive Assessment Team Reports on benefits and use of grain fumigants. These reports are reviewed, along with reports on risks associated with use of the compounds, to determine whether registration and use of the pesticides should be continued.
Family Financial Planning and Management	Mississippi Extension Service emphasized credit management, estate planning, and budgeting the family dollar in 584 workshops. One program helps families reduce their debt load over a 3-year period; another accelerates family economic stability through courses on spending, borrowing, protecting savings, investing, and sharing.

Food and Fitness Campaign	Lead agency in USDA's Food and Fitness campaign, Extension Service coordinates State participation. Cooperative Extension staffs are providing many activities, including workshops, seminars, exhibits at malls and fairs, and mass media efforts.
Forest, Range, and Wildlife Multiple-Use Management	Several State Cooperative Extension Services are developing and using computer investment decisionmaking programs and providing training for landowners, county agents, and others to use these tools. The programs involve a multidisciplinary approach that allows recognition and conservation of forest, range, and fish and wildlife benefits.
Economic Development Programs for Communities	Community action teams in Utah developed a systematic approach for four communities faced with unemployed workers to mobilize resources to handle shutdowns. Through publications, seminars, and mass media, community leaders, company and union officials, and workers statewide benefited. In Michigan, workshops on starting a small home business led nearly half those attending to begin new businesses with average investment of $5,000.
Leadership Development	Nearly 20,000 4-H members are involved in computer projects nationwide. Kentucky leads enrollment, first introducing computers at 4-H summer camps in 1980. Forty-three 4-H clubs in 26 States received Citizenship-in-Action grants for innovative citizenship and community involvement projects and programs. The Reader's Digest Foundation provides seed money for this program, a cooperative effort of National 4-H Council and Extension Service-USDA.

Library Reorganization	The Library was extensively restructured in May to reflect its expanded national and international responsibilities. Changes include strengthening library services by organizing the reference function into agricultural subject areas such as economics/marketing and farming/forestry and incorporating the former Food and Nutrition Information Center as part of a Food, Nutrition, and Human Ecology Staff. The information systems operation was expanded to give greater emphasis to computers, telecommunications, and other new technologies in the operation of a modern library. Also, the D.C. Branch Library is being renovated to serve as a reference information center.
Controlled Vocabulary for Searching AGRICOLA Database	The first controlled vocabulary for searching AGRICOLA, the Library's bibliographic database, will be implemented beginning in 1985 with the adoption of the thesaurus developed by the Commonwealth Agricultural Bureaux (CAB). The NAL and the CAB will cooperate in future vocabulary development, including incorporation of NAL requirements wherever possible. Further, the CAB and the U.N. Food and Agriculture Organization (FAO) have agreed with NAL to work for greater compatibility between their controlled vocabularies.
Electronic Storage, Dissemination of Information	Four separate evaluation studies involving electronic storage and dissemination of information were conducted in cooperation with the Department's Science and Education agencies. Three of these are directly related to full text database transmission, representing a major step forward from the citations contained in the AGRICOLA bibliographic database currently available online. These pilot projects include laser disks, full text online storage and retrieval, and photocomposition tapes for a full text database. A fourth study is concerned with potential online availability of agricultural source directories.
International Collection, Delivery of Aquaculture Documents	In a project coordinated by the Food and Agriculture Organization (FAO), the library began working with the National Oceanic and Atmospheric Administration (NOAA) and the Aquatic Sciences and Fisheries Information System (ASFIS) to provide document delivery services for aquaculture materials collected worldwide, processed by ASFIS, and incorporated into the NAL collection. Also, the library recently acquired the entire aquaculture microfiche collection of the Virginia Institute of Marine Science (VIMS) as part of a cooperative indexing agreement with VIMS.
Cooperative Cataloging Through New Libraries Network	The establishment of a network of libraries to participate in a cooperative cataloging project of agriculture monographs was proposed. Although the project would initially address coordination only with OCLC (Online Computer Library Center, Inc.), of Dublin, Ohio, and participation of OCLC member

libraries, future plans include expansion to other interested member libraries with agricultural collections. The records prepared as a result of this project will be accessible in AGRICOLA and for the Library of Congress Cataloging Distribution Service.

Translations Program for Researchers, Extension Workers

Translation of foreign-language publications on agricultural science and technology will be more broadly available to Department personnel and other agricultural researchers and extension workers nationwide under a new agreement with the Office of International Cooperation and Development. Special Foreign Currencies, as authorized under Public Law 480, will be used to pay for overseas translation of journal articles, monographs, reports, etc. The memorandum of understanding between the two agencies continues a program previously underway.

Data Assistance for Floriculture Industry

Secretary Block signed an agreement under which the American Florists Endowment made a $30,000 gift to the NAL to be used for distributing information on floriculture to growers, wholesalers, and retailers in the floriculture industry. The agreement was prompted in part by the recent donation to the library of a major collection of bibliographic and related materials in floriculture economics from the Fossum Foundation Library of North Dakota State University. These materials will be added to the NAL's extensive literature on floriculture.

Publications Exchange With Soviet Union, PRC

Arrangements for the exchange of agricultural publications with the Soviet Union and the People's Republic of China (PRC) were significantly improved through the negotiation of new and expansion of existing agreements. In the case of the PRC, the closer ties resulted largely from a dramatic increase in the number of delegations and individuals from that country visiting the NAL. Also, China National Publications of Beijing became a new subscriber to the AGRICOLA sales tape.

DEPARTMENTAL OBJECTIVES

Several of the top 16 USDA objectives for the future, as determined at the Secretary's Top Staff Conference in July 1982, are directly related to the food and agricultural sciences. These include:

Help Farmers Market Their Products	Research and education agencies will improve the knowledge and information bases available to agricultural producers concerning presently available marketing alternatives; identify opportunities for developing new marketing alternatives; provide information, training, and technical assistance to producers which will improve their marketing skills, practices, and strategies.
New Products	Develop a research program that will provide the technology needed to produce new agricultural and forestry crops to meet national needs; provide for crops for arid lands, problem soils, strip-mined areas, and family farms; and develop new crops that will supply new medicinals, gums, waxes, resins, oils, proteins, hydrocarbons, and fibers for industrial use and new crops to replace crops in chronic surplus.
Increased Efficiency	Conduct fundamental research on the physical and biological aspects of agricultural and forest products and the processes by which they can be preserved, converted into safe and useful products, and transported from producer to consumer; conduct economic research on costs and efficiency in the marketing system, and the economic performance of markets for agricultural and forest products; and provide for the extension of technology and market intelligence to producers, marketers, and consumers.

NATIONAL PRIORITIES RECOMMENDED BY THE JOINT COUNCIL

The national priorities recommended by the Joint Council reflect the different driving forces at local, State, and Federal levels that embody national concerns. The JC in 1984 formulated nine national priorities and resources needed for FY 1986 as follows:

Basic Biotechnology Research

A basic understanding of biological processes is a prerequisite to significant advances in the production of food, fiber, and forest products. Research on bioregulating and biosynthetic mechanisms at the molecular and cellular level is needed so that plants and animals, including micro-organisms, can produce food and fiber more efficiently.

Sustaining Soil Productivity

The soil resource is a primary determinant of crop and forest productivity. Farmers' efforts to maintain shortrun cash flow often cause them to use production methods that contribute to soil erosion and the loss of long-term soil productivity. More conservation tillage practices should be encouraged, and research is needed to evaluate the economic attractiveness of alternative soil erosion control practices.

Scientific Expertise Development

The strength of U.S. food and agricultural science and education depends on the quality of the people in scientific and technological leadership positions. Leaders with great intellectual capacity and ability are needed to turn the new and exciting possibilities in agricultural science and education into academic and scientific innovations that will strengthen the Nation's future. To maintain and extend our position at the forefront of agricultural technology, we must accelerate the changes in our educational system to assure the development of scientific and professional expertise.

Water Management

Water is the key to both agricultural productivity and economic stability. Water use and availability are particularly important in the High Plains and in the Western States. We should identify procedures for more efficient water use where these problems exist. Farmers and natural resources managers must be better informed on the consequences of diminishing water supplies and water-polluting practices.

Plant and Animal Efficiency, Including Protection

Integrated management programs which coordinate inputs from many disciplines are needed to increase the efficiency of plant and animal production. Developments in plant genetics can improve production efficiency with no increase in cost. Improved efficiency may result from several factors including better pest resistance and increased yield. More information is needed on animal disease control, reproduction, and the physiological bases for product synthesis.

Human Nutrition

Consumers are increasingly conscious of the relationship between their health and the quality and quantity of their diets. They

	are also concerned about the nutritive value and safety of the food they eat. To enable people to knowledgeably establish desirable eating behavior, information is needed about food, the availability of food nutrients, and the relationship between nutrition and health. Research is needed to define thresholds of deficiencies which cause mildly adverse effects and which may impair function. Such knowledge will help us to understand the relation between nutrient intake and the ultimate expressions of human genetic potential.
Communications Technology/ Information System	Electronic communications and computer technology can help users make intelligent production, management, marketing, and consumer decisions. Educational programs should be developed to enable expanded use of interactive communications systems and use of computers for decisionmaking. Software for decisionmaking within and among many enterprise systems is needed.
Agricultural Policy Analysis/Market Development	The United States is expected to continue to play a central role in world agricultural and forest product markets. Increased attention should be directed to enhancing foreign market development. There is a need for better worldwide estimates and projections of the supply and use of crops, livestock, and timber. Changes in weather and international economic policies cause export demand to vary and create an uncertain operating environment for producers, suppliers, and consumers. Farmers and agricultural businesses need more information on foreign and domestic factors that influence markets.
Forest, Range, and Pastureland Productivity Enhancement, Including Multiple Use	Forests and grazing lands are the dominant categories in the United States. These resources must be managed and used wisely if Americans are to obtain the full complement of values from them. Some critical issues are low productivity levels of both land classes, especially on small forest holdings; effects of acid rain; conflict between timber harvest and wildlife habitat; and efficiency of grazing land use for livestock production.
Resources Needed	The active pursuit of priorities identified by the Joint Council will require both redirection of current programs and new funding. The JC feels strongly that additional Federal support is well justified. The opportunity to develop new human resources, knowledge, and agricultural technology has never been greater. The need to transfer this new knowledge and technology to producers and consumers is equally great. When necessary, the agricultural science and education system can and will direct programs. The potential for redirecting programs is not without limits, however, because the system must maintain a broad program base to continually update current technologies, respond to unforeseen occurrences, and educate future managers and scientists.

USERS ADVISORY BOARD RECOMMENDATIONS

The National Agricultural Research and Extension Users Advisory Board (UAB) report of July 1984 entitled "Science and Policy Issues" included the following recommendations.

Biotechnology Regulatory Coordinating Commission	Establish a temporary Biotechnology Regulatory Commission which would report to the Office of Science and Technology Policy (OSTP).
Competitive Grants Program	Reauthorize the Competitive Grants Program and restrict the use of funds to basic research.
Joint Report on Scientific Manpower Needs, etc.	Expand studies being conducted by the National Academy of Sciences (on a national strategy for biotechnology and evaluation of the level of competency of USDA research personnel) to prepare a joint report on "manpower needs, scientific qualifications, recruitment process, and organizational delegations of authority to establish sufficient biotechnology expertise."
USDA Special Grants Program	The USDA's Special Grants Program should be refocused and funded by Congress to strengthen the State agricultural experiment stations, support multi-institutional work to reduce agricultural input costs, and provide for increased effort in biological and economic sciences.
Centers of Excellence	Competitive Grants legislation to establish Centers of Excellence aimed at increasing production efficiency which will help ensure U.S. products a competitive advantage in the world marketplace.
Increased Economic Research	Direct more Federal funding to economic research designed to expand food and fiber exports.

PROJECTED COOPERATIVE EXTENSION PROGRAM EMPHASIS, 1983 AND BEYOND

The Extension Service-USDA performs a key role in support of the USDA mission and goals listed earlier. The Smith-Lever Act of 1914 established the Cooperative Extension Service (CES) system as a unique national partnership of Federal, State, and local governments. The Federal/State/local partnership is the structural and organizational cornerstone of the system.

The mission statement of the national Cooperative Extension System reads: "The mission of Extension is to improve American agriculture and strengthen American families and communities through the dissemination and application of research-generated knowledge and leadership techniques."

Goals

The goals of the Cooperative Extension System provide continuity and focus for the mission. They are based on the expressed needs of people, legislative mandates, and funding requirements. The goals are listed below:

- To develop efficient agricultural, forest, and rangeland production systems.
- To enhance the processing, marketing, and distribution of high-quality food and fiber products.
- To support the conservation and wise use of natural and renewable resources.
- To strengthen the family and home through the attainment of knowledge, human skills, and technology needed to create a satisfying quality of life within available resources.
- To assist youth in acquiring knowledge, developing life skills, and forming attitudes that will enable them to become self-directing, productive, and contributing members of society.
- To strengthen the capacity of State and local governments to deal with public issues and problems.
- To cooperate with agencies and institutions of Federal, State, and local government and the private sector in developing and conducting educational programs.
- To cooperate and work with national and international institutions throughout the world in using the Cooperative Extension Services' concept of informal education.

High-Priority Program Issues

Nine high-priority program issues for the Extension Service partners have been identified within the goals for FY 1984 and beyond. These are an integral part of Extension programs at National, State, and local levels and are:

- Crop and Animal Production Efficiency.
- Financial Management.
- Food and Fiber Marketing Management.
- Forest and Rangeland Management.
- Management and Conservation of Soil and Water Resources.
- Human Nutrition and Health.
- Leadership Development for Adults and Youth.
- Local Government Operations and Finance.
- Small Business Development and Management.

Implications

Cooperative Extension Service priority program issues tend to relate closely to a number of the recommendations made by advisory groups and the science and education related objectives of the Department. However, as with research administrators' projections, a "tight" correlation is not apparent. Not all the entities and organizations with a stake in the functioning of the Federal-State research and education system are represented in this report. For example, State and local governments, which fund the system on an approximately equal basis (in total) with the Federal Government are not represented directly in any of the advisory or executive groups mentioned in this report. This multiplicity of "guiding entities" is not a recent phenomenon, but has existed essentially from the beginning of the food and agricultural research and education "system" approximately 100-120 years ago.